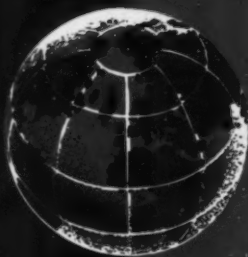


APRIL 1959

VOL. 21 NO. 4

MINING WORLD



★ Special Report

Arizona

Fluidizing

Symposium



Steel Sets Hold Deadman Shear

Page 20

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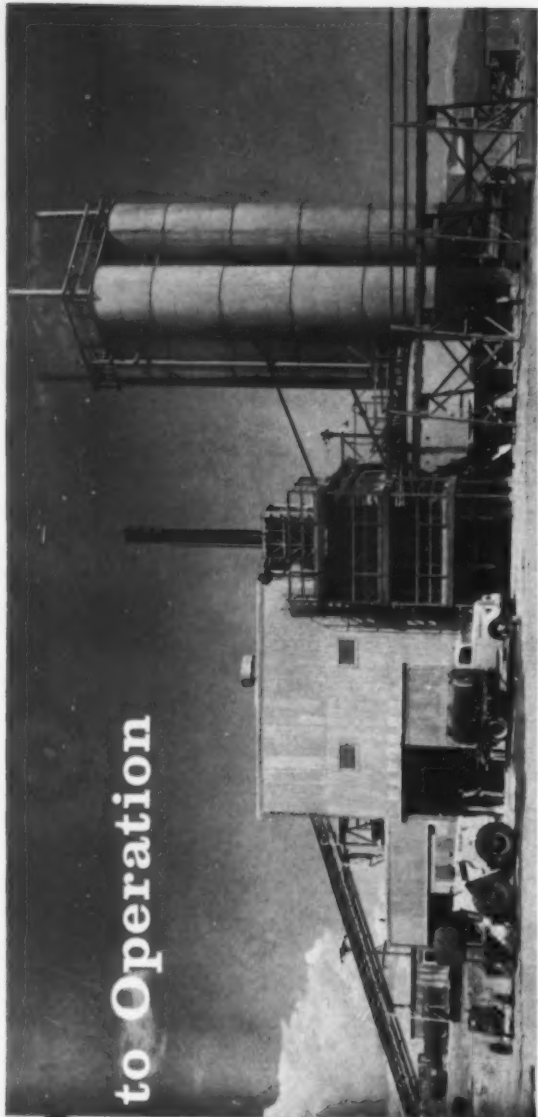
from Excavation

*Experience, planning, and cooperation
make possible the record breaking*

*construction of the new
Cotter Corporation Uranium Mill.*



APRIL 21—The first ground is broken on the site of the Cotter Plant near Canon City, Colorado. The fullest possible cooperation of Cotter Corporation officials greatly speeded construction.



JULY 19—Production started, but WKE engineers are still on the job to insure the most efficient operation of the plant at its designated capacity. The final tally shows the job completed ahead of schedule and below the estimated cost figure.

Send For Complete Information

Department M. W.



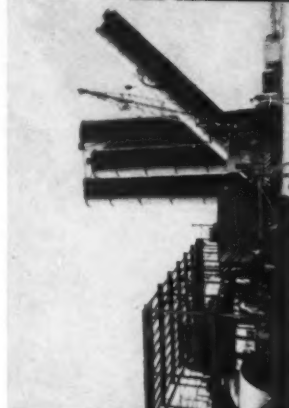
WESTERN-KNAPP ENGINEERING CO.
SAN FRANCISCO • NEW YORK • CHICAGO • HIBBING

MAY 19—One of many innovations used to speed construction was this solid slab used in preference to time consuming individual footings. AEC contract commitments made every minute count.

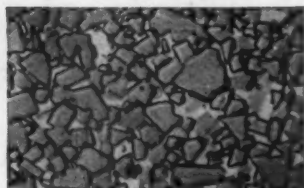
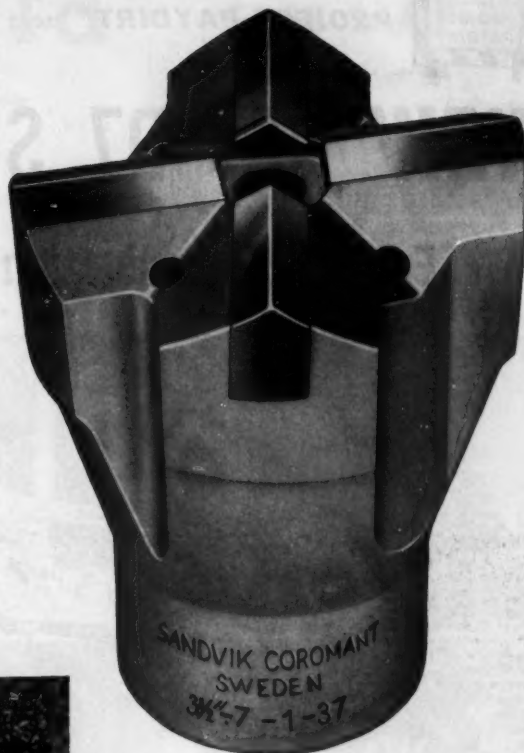
MAY 26—Building sections of the mill frame on the ground and hoisting them into place was another common sense, clock-beating technique used by WKE engineers. Techniques like this kept production up—overtime down.

JUNE 9—The fourth Pachuca leach tank is set in place just forty-nine days from the start of the job. These tanks and other large equipment units were prefabricated, simplifying erection on the job site.

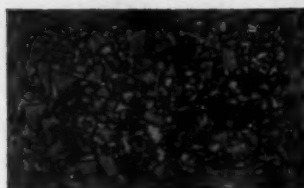
JUNE 16—The nearly completed exterior of the plant shows in the background as workmen finish installing ore conveyors. With nine other Uranium Concentrators on the completed list, WKE experience was the big plus in the battle against time.



Longer bit life— with *new* Sandvik Coromant Bits



Sandvik Coromant Tungsten Carbide
(Microphoto) Uniformity of size, even distribution of grain are marked. Free from porosity and impurities—therefore stronger, longer-lived.



Low quality Tungsten Carbide
(Microphoto) Black marks are contaminations caused by deficient production control. They weaken the carbide, reduce its working life.

Sandvik Coromant Detachable Bits are Available in the following Thread Sizes and Bit Diameters

		Available Diameters, in Inches																			
Type	Thread	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	4 3/4	5				
SHOULDER	TAPER	x	x	x	x																
	F		x	x																	
	113		x																		
	H			x	x	x	x	x													
	115			x	x																
	D					x	x	x	x	x	x	x	x	x							
BOTTOMING	K															x	x	x	x		
	1" Rope				x	x	x	x													
	1 1/4" Rope					x	x	x	x				x								
	400					x	x		x												
	1 1/2" Rope												x	x	x	x					
	600												x	x	x	x					
	700															x	x				
	17.5																	x	x		
	2" Rope																	x	x	x	x
	1000																			x	

NEXT time you buy bits, specify Sandvik Coromant because they give more footage per bit, lower drilling costs. Here's why:

- 1 Only first-quality tungsten carbide is used—as shown in the microphotos above. This means less wear, longer life and a better job.
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- 3 The bigger Sandvik Coromant bits are all of X-design, which prevents rifling. No wonder Sandvik Coromant inserts are the most widely used in the world, drilling more than one billion feet every year.

SANDVIK COROMANT bits are supplied through Atlas Copco, the world's largest manufacturer of rock drills, who also supply Sandvik Coromant integral steels—the most widely used in the world—and Sandvik Coromant extension steel equipment.

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San Carlos, California
LYtell 1-0375



PROJECT PAYDIRT* *pays off again*

NEW CAT D7 SERIES D TRACTOR

For higher production at lower operating cost



BY ANY comparison the new Cat D7 Series D Tractor is champ in its class. It packs 140 horsepower . . . matched with 80% more lugging ability than the previous model—for greater production. And it delivers this production at lower operating and maintenance costs. The payoff for you . . . increased performance that no other tractor in this power range can match.

Major improvements, developed by Caterpillar's Project Paydirt, affect the engine, power train and undercarriage. And the new Series D retains the exclusive Caterpillar Oil Clutch. It's time-tested; delivers up to 2,000 hours—one whole season—without adjustment.

For complete facts about the leader, see your Caterpillar Dealer. He's ready to give you the whole story on the new D7 Series D. And he'll arrange a demonstration on your job.

Caterpillar Tractor Co., San Francisco, Cal.; Peoria, Ill., U.S.A.

* **PROJECT PAYDIRT:** Caterpillar's multi-million-dollar research and development program—to meet the continuing challenge of the greatest construction era in history with the most productive machines ever developed.

NEW ON THE D7 SERIES D

TURBOCHARGED ENGINE features 9% horsepower increase, 80% more tractor lugging ability. Optional in-seat starting is available. The payoff . . . more production!

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Mining World

Including the Export Edition WORLD MINING

Published monthly except in April when publication is semi-monthly

VOLUME 21

APRIL 1959

No. 4

OPERATIONS—TECHNOLOGY

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By WALLACE E. CRANDALL

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Fluidizing Symposium

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Exploration Is Theme of AIME's San Francisco Meeting 39

Geologists and geophysicists report many mineral discoveries in Canada and United States. John B. Knaebel accepts Saunders' medal.

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ON THE COVER

Yes, that 8-foot diameter Bethlehem yieldable steel arch set has been squeezed into an egg shape by heavy ground. Actual measurement shows the 96-inch set has been squeezed to 72-inches. The article starting on page 20 by Wallace Crandall, chief engineer, Hecla Mining Company, Wallace, Idaho tells how yieldable steel sets made it possible to drive the Silver Mountain cross cut through the Deadman shear. Greatest pressure was exerted in the upper left hand section of the ring, at about a 40° angle with the strike of the cross cut, and toward the face (direction in which camera was pointed).



MILLER FREEMAN PUBLICATIONS



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GRAB SAMPLES From the Mail

Patented Nickel Process

Dear Sir:

The Dutch Foreign Affairs Minister has announced that some American company had joined a Dutch company for the purpose of developing the vast nickel deposits of New Guinea.

I have been trying to establish the identity of the American (Steel?) company in order to present for its consideration my process for handling these ores. (United States Patent 2,468,103). This process was developed mostly for the Oost-Borneo Maat. of the Hague, Holland for use in refining its similar ores in the Celebes.

Any assistance you can render in this instance will be appreciated.

GEORGE W. PAWEL
Metallurgical Engineer
Norris, Tennessee

Mining World's Holland correspondent reports that the United States Steel Corporation is interested in these deposits with two Dutch firms.—Ed.

Singing Night with WORLD MINING

Dear Sir:

I wish to thank you for WORLD MINING which I have been receiving for some considerable time, and for the regularity with which it is sent,—looked forward—and received.

Articles of world interest and current news items I find are well ahead of our local mining publications. I think the "Index of Published Material" in the December issue a useful addition to the Magazine, and the metal price list has always been an interesting item.

On my own "Small Workings" some 20 miles from Selukwe, I have spent many a late night while the crickets and frogs are singing and the many insects circling the lamp, thumbing through the pages of WORLD MINING. At one time, some 20 years ago, these hills echoed with the sound of Stamp Mills, but today I am about the last in the area the others have had to close down, not so much from the lack of gold but the ever increasing cost of commodities and wages. Of late there has been a considerable interest shown by mining companies in this area using modern prospecting methods for base metals.

Yours faithfully,

W. J. RAINSFORD
Pompeii Mine
Southern Rhodesia

Euclid's in Ireland

Dear Sir:

We have noted that in the December issue of WORLD MINING there appeared under the International News page an article reporting the official opening of St. Patrick's Copper Mines Ltd. This article specifically mentions the use of rubber-tired Caterpillar DW 21 units on this project.

We, as Euclid distributors for Ireland, would like to draw your attention to the fact that there are three S-7 Euclid rear dumps being used to haul ore out of the mines carrying a pay load of 15 tons up a 11 percent grade.

Blackwood Hodge (Ireland) Ltd.
Long Mile Road
Dublin, Ireland

How to get more tractor for your dollar

In the chart below are five important crawler tractor advantages. These features have earned recognition by all makers of crawler tractors—one or more are now included in their latest designs. It stands to reason that the more of them you get on your next crawler, the more it is worth to you.

Advantage	What it means to you	Where you get it
All-steel main frames	Power train protection Better equipment mounting Better weight distribution	Allis-Chalmers is the only manufacturer offering main frames in <i>all</i> models. Two other manufacturers now offer them in one model.
Permanent lubrication of truck wheels, idlers and support rollers	No more wasted time greasing these track components	Allis-Chalmers is the only manufacturer offering permanent lubrication of truck wheels, idlers and support rollers on <i>all</i> models. One other manufacturer offers permanent lubrication on three models.
Torque converter drive	Matches power to load automatically Transmits power smoothly Less shifting	Allis-Chalmers pioneered it in crawler tractors in 1940 . . . offers it in two tractor shovel models, two tractor models. All other major manufacturers now offer it as optional equipment in one or more models.
Double reduction final drives	More clearance Longer gear life	Allis-Chalmers is the only manufacturer offering double reduction final drives on <i>all</i> models. One other manufacturer offers it on three models.
True unit construction	Faster service Easier access to all major assemblies	Allis-Chalmers is the only manufacturer offering true unit construction in <i>all</i> its models. Two other manufacturers now offer modified unit construction in part of their lines.



Here's proof that other manufacturers of crawler tractors have chosen to "follow the leader" with Allis-Chalmers engineering . . . and that your Allis-Chalmers dealer is the man to see for top value in crawler tractors.

He'll be glad to demonstrate the model of your choice. It will have more industry-approved advantages than any other unit near its size. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

...move ahead with **ALLIS-CHALMERS**...power for a growing world

Mining World

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APRIL 1959

Drifts and Crosscuts

No Hope For Gold Price Increase

With two new Senators from the gold mining state of Alaska, it's only natural that a campaign is underway for an increase in the price of gold. Let's take a look at Washington to find how tough the campaign will be and the road blocks ahead.

The Treasury has stated its opposition to legislation calling for the sale of gold on the free market. This bill, the Treasury said, would have the "effect of creating variable prices for gold in terms of the dollar in domestic and foreign markets."

The department's opposition was expressed in a letter by Lawrence B. Robbins, acting secretary, to the Senate Banking Committee reporting on the bill (S. 164) introduced by Senator E. L. Bartlett of Alaska.

"Our goals of economic stability and sound money," Mr. Robbins stated, "require a continuation of our policy of maintenance of the price of gold at \$35.00 an ounce." The open-market proposal, he added, would in effect create a free market for newly mined and imported gold and permit unrestricted exports. This would result in a second unofficial price for gold which would fluctuate from the official government price in relation to the demand, according to Robbins.

There seems to be a general impression in gold mining circles that the price of gold would rise materially if free trading in gold were permitted in the United States, and that the price of gold on the world markets is much higher than the United States price. However, a survey of world markets late in January gives scant support to that belief. The following shows free market gold rates per 1.0 fine ounce in a variety of international markets:

Amsterdam, \$35.09; Mexico, \$34.48 (plus export tax); Beirut, \$35.205; Paris, \$35.87 (transit price); Hong Kong, \$38.08; Tangier, \$35.30; London, \$35.09 and Zurich \$35.09.

Other bills introduced in this session of Congress are:

H. R. 1016 by Hiestand of California to establish a gold standard and redeemable currency; H. R. 28 by Baring of Nevada—and similar bills by Chenoweth of Colorado and Pfof of Idaho—to permit free marketing of newly mined domestic gold; S. 164 by Bartlett of Alaska—and a similar bill by Senators Bible and Cannon—to permit a free market for domestic gold; H. R. 3064 by Rivers of Alaska—with identical bills by Barry of South Dakota and Baring of Nevada; and S. 590 by Senators Murray, Bible, Bartlett, Gruening, Mansfield, and Kuchel—to require the Treasury to pay \$70.00 an ounce for domestic gold.

The only thing certain about all bills is that the Treasury will oppose every one.



FOR CONTINUOUS SERVICE IN HEAVY DIGGING

MARION 181-M

The new levels of output and efficiency made possible on operations that can use large haulage units make the Marion 181-M a logical machine for expanded pit mining operations.

Here's a husky 8-yard machine with the traditional strength, power and endurance of Marion mining shovels - - plus small machine cycle time for an extra payoff every day.

With low-maintenance Ward-Leonard controls, power is applied smoothly and quickly,

yet held within controlled limits that safeguard the machine against undue shocks or strains.

The chain propel simplifies crawler design and provides increased protection for the final propel mechanism, especially on shovels where the drive chain is enclosed and dips in oil.

A disc-type air clutch permits the operator to engage the travel mechanism without stopping the machinery, permitting faster move-ups.

If you haven't seen Bulletin 439 on this 8-yard Marion, write for your copy today.

CONSULT



MINING SPECIALISTS

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MARION POWER SHOVEL COMPANY • Marion, Ohio, U.S.A.

A Division of Universal Marion Corporation



Capitol Concentrates

Washington Reports "Copper Quota Bill" May Follow Sugar Act To Limit Imports

Numerous rumors have been coming from Washington relative to applying the principle of the so-called Sugar Act to metals and minerals—and particularly to copper. In fact a bill has already been thrown into the Congressional hopper for fluorspar, and a study is being made to see if something similar might be helpful to domestic copper.

The proposed fluorspar bill is adapted from the Sugar Act (Public Law 545—84th Congress) in that the fixed quotas are based upon the deliveries to United States consumers for the years 1956, 1957, and 1958. The United States quota is set at about the average United States production for these years, and the import quota is the difference between total domestic consumption and the United States quota.

To these amounts, according to the formula, there would be added an amount equal to 25 percent of any excess over the initial determination of the Secretary of Interior, until such time as excess imports have equalled the average rate for the years 1956, 1957, and 1958, and thereafter 40 percent of such increase.

In the case of copper, the Secretary of the Interior would determine for each calendar year, beginning with the calendar year 1960, the amount of copper needed to meet the requirements of consumers in the United States. These determinations would be made on or before December 1 in each year for the succeeding calendar year and at such other times during each calendar year as the Secretary may deem necessary. The basis for such determination would be the quantity of copper distributed for consumption as indicated by official statistics of the Department of Commerce during the 12-month period ending October 31 next preceding the calendar year for which the determination is being made; and would make allowance for a deficiency or surplus of inventories of copper (changes in stocks), and for changes in demand conditions, as computed from statistics published by agencies of the federal government.

Following are the copper figures which could be the basis for a "copper-quota" bill.

Year	Tons Refined Copper Consumed In U. S. At Cents Per Pound	Tons Refined Copper Produced From Domestic Ore	Tons Net Imports
1956	1,521,389 @ 41.81¢	1,080,207	441,182
1957 ¹	1,347,815 @ 29.57¢	1,050,496	297,319
1958 ²	1,235,000 @ 25.76¢	990,000	245,000
Total	4,104,204 @ 33.00¢	3,120,703	984,501
Average per year	1,368,000	1,040,000	328,000

1. Preliminary. 2. Preliminary estimate.

From the above figures, the United States fixed quota for domestic copper would be 1,040,000 tons and the import quota would be 328,000 tons. Whenever consumption exceeds 1,368,000 tons, the quota would be 25 percent of the excess added to the fixed quota, and the import quota would be 75 percent of the excess added to the fixed quota.

Whenever imports have reached the average rate for the years 1956, 1957, and 1958, the proportions would be 40 percent of such excess for the United States and 60 percent for foreign. Of course, the actual figures used for consumption would be the initial determination made by the Secretary for the 12-month period ending October 31 next preceding the calendar year for which the determination is being made.

There is no doubt that a United States fixed quota of 1,040,000 tons of copper would be a satisfactory quota for the domestic copper industry, as such a figure would be equal to more than 90 percent of the present productive capacity.

• New Lead-Zinc Tariff Asked

Representative Ed Edmondson has introduced H. R. 3619, a bill designed to plug the holes in the Administration's lead-zinc quota system. It would increase tariffs on semi and finished products which are not now covered by the quota system. These increased tariffs would go into effect when the price of lead is under 17 cents per pound and the price of zinc is under 14.5 cents per pound. The present quota system has set up a dangerous patchwork system whereby articles made of cheap lead and zinc may be imported to defeat the purpose of the quota system.

• Percentage Depletion Is Under Fire

Senator Proxmire of Wisconsin has jumped into the percentage depletion act with both feet. Following the Administration line, his S. 893 would amend the Internal Revenue Code to define a specific "cut-off point" by limiting depletion to "the extraction of the ores or minerals from the ground." The courts have given various interpretations in the past and have at times extended the depletion principle over various subsequent processes than just mining. The Proxmire formula will not be popular with mining people as it appears to be entirely too restrictive.

• Department's Mineral Program Is Missing

Secretary of the Interior Fred Seaton appeared before the House Interior and Insular Affairs Committee on February 18 and testified to the program that the Department of the Interior expects to present to the Congress. While his proposals covered the waterfront—from Indians to helium—Secretary Seaton said that there will be no program for metals and minerals excepting research work. As excuses, Seaton explained that copper is in good shape, lead and zinc are being taken care of by the quota program (and that the beneficial effects would not be felt for several more months), that the Interior Department got its ears knocked down by the House of Representatives last year so there is nothing to be gained by presenting similar legislation, and that with the stockpiles filled there is no use of trying to do anything about chrome and similar minerals.

All in all, it is a bleak prospect for our American mineral producers and miners, when the Administration has no program to offer them, yet is doing everything possible for foreign operators. Of a large part of the domestic mining industry one could say, "Sic transit gloria mundi."

**"ESCO SCRAPER CUTTING
EDGES HAVE GIVEN US
COMPLETELY BREAKAGE-FREE
OPERATION"**



**States Superintendent Patrick Dennergy,
J. Robert Bazley, Inc., Centralia, Pa.**



**Stop breakage on your job by insisting on
ESCO Scraper Cutting Edges. See your
ESCO dealer for details, or write direct.**



"We have to fight for every inch of soil we remove", explains Dennery, superintendent on the J. Robert Bazley, Inc., open pit coal mine at Centralia, Pennsylvania. "And cutting edge breakage seriously affects the efficiency of our operation. The scraper cutting edges we were using previously were prone to breakage. Gashes up to 4" deep would occur. But *ESCO* blades, which we have been using exclusively for over three years, have never shown the least sign of chipping.

"Furthermore", continues Dennery, "*ESCO* scraper cutting edges give us longer service than our previous blades. The task of reversing or replacing blades is definitely made easier by *ESCO*'s two-section design of the center blade." Concludes Dennery, "*ESCO* Scraper Cutting Edges give us the low down-time insurance that is imperative on our operation."

QUICK-CHANGE CENTER SECTION

Four-piece design of *ESCO* scraper cutting edges simplifies the task of reversing center sections and reduces down-time.



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TO MEN
ON THE
MOVE:



WHERE THERE'S BUSINESS ACTION THERE'S A BUSINESSPAPER

In any kind of racing—man, beast, or automotive—the "inside track" is the favored position.

Same holds true in the business race. But here the "inside track" means having more information—sounder information, more complete information, more timely information. The astute businessman—the man on top and the man on the way up—gets that information from the businesspaper he subscribes to in his particular field. He reads for profit, not for pleasure. He searches for facts he needs to make decisions. For fresh ideas. For new methods. For new products he can put to work. He reads, in short, to get the "inside track" against competition.

And he finds much of what he wants and needs in the advertisements in his businesspaper. So, logically, he reads the advertising with the same scrutinizing care he devotes to the editorial pages.

Take a tip from the man on the move who wants to keep his job and his business *moving*—on the "inside track." Subscribe to your businesspaper. Read every issue. Carefully. Thoroughly. Searchingly.

MINING WORLD



A MILLER FREEMAN PUBLICATION





Little Furnace Makes Money for You

But for this little furnace you wouldn't be getting the irresistible cutting power or the footage or the diamond salvage that Truco Bits deliver today.

When our metallurgists developed our patented system for anchoring diamonds nearly twenty years ago, part of the secret lay in the sintering process by which diamonds were anchored in a solid, tough, metal bed which also developed a chemical bond with the diamonds and held them in a vise-like grip that was the wonder of the industry.

The sintering demanded precise control and

these electric ovens were developed to sinter the powdered metal bed and bit blank into a solid amalgam without injuring the diamonds and without allowing them to move from their carefully set position, each with "best face to the work" for maximum cutting power.

Metals produced by this process cling to diamonds through toughest abrasive conditions and when the bit is finally pulled, there are more salvable diamonds there than you have any right to expect, except in a Truco.

That's one of the reasons why Truco Bits cost less. Try a Truco and see for yourself.



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6596



One man operated GISMO® Transloader

- . . . with round-trip travel 1,600 feet
- On shorter hauls tonnage ranges up to 2-tons a minute.
- On longer hauls, tonnage ranges down to 1-ton a minute.

This HIGH tonnage production is accomplished by:

One Man

One S-D Gismo Transloader

How can one man and one piece of equipment do so much work? Because the Sanford-Day Gismo Transloader is BOTH a mucking-machine and a truck ALL-IN-ONE!

It is a high-speed transport — up to 20-miles per hour either direction! The fact it self-loads enables you to completely eliminate idle time of both men and equipment! Therefore, less capital investment required for additional equipment and manpower to do the job.

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Compare this with the S-D Gismo Transloader. When Transloader is operating, man and equipment are working all the time; either mucking or transporting to dumping point! **NEITHER THE TRANS-LOADER NOR ITS OPERATOR ARE EVER IDLE!** They are continuously at work in uninterrupted cycles!

Visualize one or several S-D Gismo Transloaders, each with only one man, **MUCKING AND HAULING** in your development or production work. Savings are tremendous! Write or call us today. *Manufactured by Sanford-Day Iron Works, Inc., Knoxville, Tenn.*



This photograph catches the action of the S-D Gismo Transloader mucking out a load.

Conventional Method



**ONE MAN
AND TRUCK
IDLE!**



**ONE MAN
AND LOADER
IDLE!**

Transloader Method

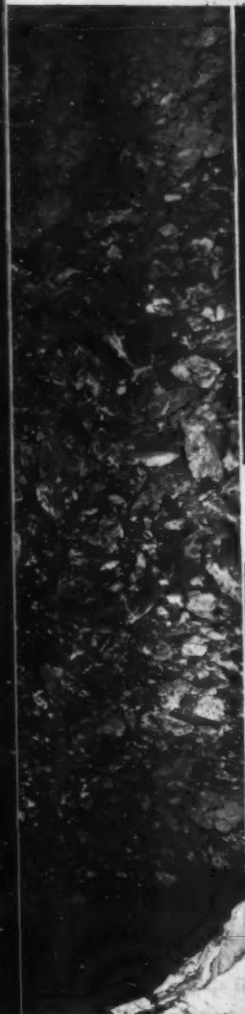


LOADING



TRANSPORTING

"Mucks-Hauls-Dumps" 100-tons an hour!



Here you see S-D Gismo Transloader with large, wide dipper down under hard rock. Transloader makes its own roadways and cleans-up completely . . . also moves large boulders for secondary blasting.



. . . and here is dipper raised with full load. This high-powered, high-speed Transloader operates on grades, in favor or against the load . . . negotiates, turns, etc.



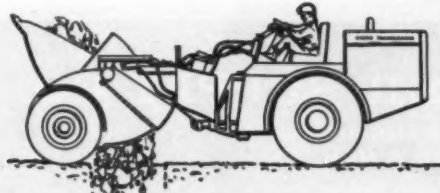
This tramming scene (on way to raise) shows S-D Gismo Transloader as truck-transport.



Here load is being dumped into raise. Transloader also backfills waste, or dumps directly into bin . . . or by simple ramps over trucks, cars, conveyors, etc.

THE GISMO TRANSLOADER, rubber-tired Gismo Self-Leading Transport, is an advanced equipment development that is a perfectly natural result of the performance of the Gismo powered by crawler-mounted tractors developed a few years ago and doing an outstanding job in mechanized mining today!

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- Precision S-D Mine Wheels.
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- S-D "Brownie" Hoists. • S-D Car Spotters.
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- S-D Slusher-Trains for mining and construction industries.
- S-D Gismo Transloader for mining and construction industries.

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...that's why *they cost less to own*,
save you money every day, for years.



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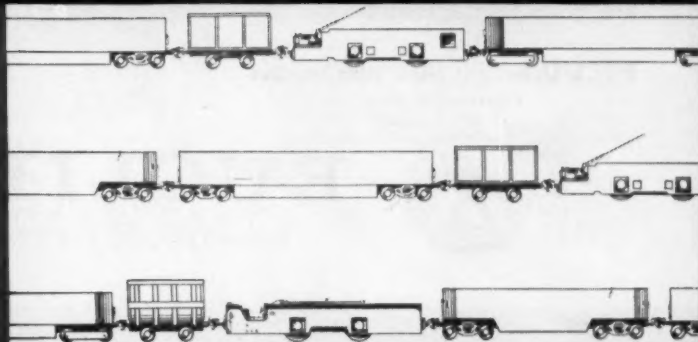
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"Eucls" have payload capacities of 10 to 50 tons—are powered by engines of 128 to 670 total h.p. . . . have loaded speeds up to 41 mph.

For Lower Hauling Costs in Mines and Quarries Check Euclid Performance

Open pit mine and quarries the world over have standardized on Euclid equipment for moving earth, rock, coal and ore on tough off-the-highway hauls. They know from years of experience on their own operations that "Eucls" get more work done every shift—that production cost is lower than with other types and makes of equipment.

Euclid has a complete range of sizes and models to fit every job requirement—rear dump and bottom dump haulers, self-powered scrapers and the world's most powerful crawler tractor. Your Euclid dealer will be glad to provide a production-cost estimate on your present or planned operations—be sure to see him before you replace or add to your equipment fleet—and have him show you why Euclids are your best investment.

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The **TC-12 Crawler** has 2 engines and independent track drive . . . 402 net h.p. . . . full power shift . . . top speed of 7.8 mph. This "Euc" tractor has unequalled work-ability for heavy dozing, ripping and similar work in mines and quarries.



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EUCLID EQUIPMENT

FOR MOVING EARTH, ROCK, COAL AND ORE

Mining World

THE IMPORTANT MINING MAGAZINE EVERYWHERE

April 1959

—INTERNATIONAL PANORAMA—

SPRUCE PINE, NORTH CAROLINA—Basic Atomic, Inc. has granted a five-year lease on its lithium properties to Texas Gulf Sulphur Company. A new Basic patent for recovery of lithium from spodumene is also included.

SAN FRANCISCO, CALIFORNIA—Jefferson Lake Sulphur Company is diamond drilling a chrysotile asbestos deposit in Calaveras County, California owned by American Asbestos Mining Corporation.

GUATEMALA CITY, GUATEMALA—The Bunker Hill Company and W. R. Grace & Company have formed a joint venture firm called CAMAGRA to explore the 300-year-old Torlon lead zinc mine at depth. More than 50,000 tons of lead have been produced from mine workings less than 100 feet deep.

GARFIELD, UTAH—Kennecott Copper Corporation has plans to spend \$10,000,000 to modify the recently purchased Garfield copper smelter. A new top feeding system of concentrate to reverberatory furnaces is being considered.

SAN FRANCISCO, CALIFORNIA—An all-time monthly output of newly mined copper on a world basis was set in January at 260, 378 tons.

MOUNT ISA, AUSTRALIA—Mining Corporation N. L. has deepened its No. 1 diamond drill hole to 3,046 feet in the search for an extension of the copper lode of Mount Isa Mines Ltd. Fifty feet of core between 2,952 and 3,029 feet assayed 1.35 percent copper.

POWDERHORN, COLORADO—The Du Pont Company has acquired large reserves of columbium ore from the Gunnison Syndicate, Humphreys Gold Corporation, and others. This ore will be held in reserve for future columbium metal production.

MOAB, UTAH—Shattuck Denn Mining Corporation has shipped its first ore from the Thomas Bardon mine south of here after sinking the 850-foot shaft in record time.

PUERTA PRINCESA, PHILIPPINES—A record monthly tonnage of mercury ore was mined and furnace by Palawan Quicksilver Mine, Inc. in January when 6,704 tons were treated to recover 24,214 pounds of mercury.

THE HAGUE, HOLLAND—The United States Steel Corporation and three Dutch firms have been awarded concessions in Netherlands New Guinea to explore for and mine nickel, cobalt, and iron.

BAGDAD, ARIZONA—Cyprus Mines Corporation has reopened its Old Dick copper-zinc mine and mill after a year's shut down. Higher grade ore has been developed.

DARWIN, AUSTRALIA—A special 22-square-mile bauxite lease on the Gove Peninsula has been granted by the Commonwealth government to Commonwealth Aluminium Corporation Pty., Ltd.

SILVERTON, COLORADO—Marcy Shenandoah Corporation has leased the Sunnyside mine of United States Smelting Refining and Mining Company. Standard Uranium Corporation is associated with Shenandoah and under lease terms will extend the low level American Tunnel and raise to Sunnyside's deep workings.

LA PAZ, BOLIVIA—Barter arrangements have been made for 5,000 tons of tin for the United States Stockpile. Concentrates will be smelted in England and refined tin shipped to the United States.

VANCOUVER, CANADA—Two major United States copper firms, Phelps Dodge Corporation and Kennecott Copper Corporation, are busy staking claims on northern British Columbia discoveries. PD is staking asbestos on Telegraph Creek and Kennecott molybdenite southwest of Dease Lake.

Marcy-Shenandoah Leases U.S. Smelting Property

Marcy-Shenandoah Corporation, in association with Standard Uranium Corporation, has begun development work on the Sunnyside lead-silver-zinc properties near Silverton, Colorado.

The Sunnyside property was leased to Marcy-Shenandoah last month by United States Smelting Refining and Mining Company for a term of 15 years, with option to renew for a further term of 25 years. According to the lease, Marcy-Shenandoah will extend the American Tunnel, now 6,800 feet long, to the leased premises, another 4,800 feet. It will also drive a vertical raise connecting the tunnel to existing mine workings to provide access at lower levels to anticipated ore horizons. Standard Uranium Corporation will be the operator in this large development.

The Sunnyside mine was closed about 20 years ago. The American Tunnel, originally started in order to open up this mineralized area as a transportation and drainage tunnel, will be rehabilitated and extended to the Sunnyside properties.

Marcy-Shenandoah Corporation was organized in 1957 for the purpose of consolidating the various mining properties in the Silverton district. The new company began with the purchase of the Shenandoah-Dives Company mill and mine, with a 850 to 680 tons daily capacity, and an option on the Old Hundred, one of the mines located in Cunningham Gulch. Over the past several months, S. Stokes Tomlin Jr., president of Marcy-Shenandoah, has leased other mining properties including some from the American Smelting and Refining Company in the Shenandoah area, and has obtained easement rights from the Gold King Company at Gladstone for driving the American Tunnel to unwater the Sunnyside workings.

A limited partnership, finalized March 6th between Marcy-Shenandoah and Standard Uranium Corporation, unites the leased properties of the former with the important Standard Uranium holdings in this area. For an undisclosed consideration, Standard Uranium purchased 50 percent of the assets of Marcy-Shenandoah and an option for a period of 36 months to purchase the remaining 50 percent.

Consolidation of these properties in the Silverton district is a major step which may mean the reopening of non-ferrous metal mining in historic San Juan County, Colorado district, according to Standard Uranium's president W. R. McCormick.

Next Month — Kiruna's New Central Iron Ore Treatment Plant

How Hecla Used Yieldable Steel Sets

To Hold Silver Mountain Crosscut Open

Through 452-Foot-Wide Deadman Shear

In Heaviest Ground Many Idaho Miners Ever Saw



By Wallace E. Crandall

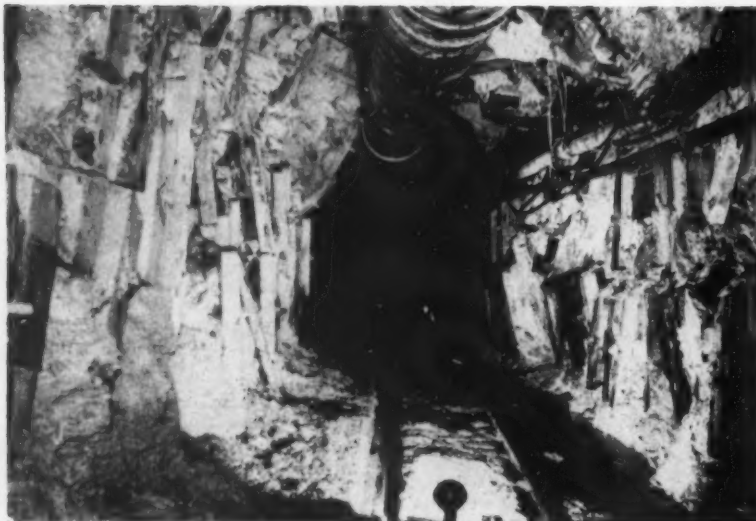
Yieldable steel arch sets, 102 of them placed in the 452-foot-wide Deadman shear zone, made it possible for Hecla Mining Company to successfully drive the Silver Mountain crosscut through exceptionally heavy ground.

The Silver Mountain Exploration Project is located two miles east of Mullan, Idaho at the mouth of Daisy Gulch on the South Fork of the Coeur d'Alene River. It is a joint Hecla Mining Company-Bunker Hill Company-Silver Mountain Lead Mining Company venture with D.M.E.A. participation. Hecla Mining Company is the operator and the work has proceeded on a three-shift basis since shaft sinking began in February 1956.

The project, as planned, involved the sinking of a 2,080-foot shaft, approximately 15,000 feet of crosscutting and drifting, and some 25,000 feet of diamond drilling. It was known that the crosscut would intersect two major faults or shear zones—the Paymaster fault and the Deadman shear zone. When the Paymaster zone and its associated faulting were intersected it was found that conventional rock bolting with 1-inch by 6-foot steel bolts was sufficient to support the ground. While the main crosscut was being extended northeasterly toward the Deadman shear zone, 3,000 feet of drift and lateral were driven westerly along the north side of the Paymaster fault zone. This westerly drift was supported entirely with rock bolts, although several areas required lowering of the track after it had heaved as much as one foot. In several areas, the entire drift wall with its rock bolts moved until it was necessary to trim the walls and re-bolt. Since many of these bolts were still solidly anchored, they were cut off, rethreaded, and tightened again. By using more than a

Neither Timber Sets Nor

Roof Bolts and Headboards
Would Hold Deadman Shear



Mr. Crandall is chief engineer for the Hecla Mining Company. His headquarters are in Wallace, Idaho.

normal number of rock bolts it was possible to hold ground which would normally have required close timbering with considerable repair. It is believed that the ground squeeze assists in giving the bolts a "grip" in the hole by squeezing the hole shut around the bolt.

Six-foot by 2-inch wooden rock bolts were tried in this area but the ground movement proved to be too heavy, resulting in failure on the bolt or head board.

Four Heavy Zones Crossed

In the Northeast Crosscut heading, four zones of weakness from 10 to 130 feet long were encountered prior to reaching the Deadman shear zone. These could not be held by rock bolts alone and the ground was both bolted and timbered. Considerable timber repair and track lowering was required, but after the initial squeeze, during the first month or six weeks, had dissipated, the ground stabilized. These sections have since required no repair.

At a point 3,350 feet northeasterly from the shaft, a fifth zone of weakness began. This was later found to be the beginning of the Deadman shear zone, which was, at this point, in the Wallace formation of the Coeur d'Alene Belt Series rocks. After cross-cutting and bolting some 65 feet, the ground became increasingly heavy and the heading was stopped while a cave at the face was timbered. It soon became apparent that this ground was too heavy to be held with conventional timber sets on 5-foot centers. The pressure against lacing buckled posts and forced them into the crosscut. Caps were reaching the breaking point in one to two weeks' time. On one occasion, during repair, it was found that posts had been driven three feet into the bottom. The wetting of the gougey material by water from the ditch and from drilling caused greater movement upward from the bottom than from any other portion of the walls or back. Fortunately, the heavy portions of the shear zone are not wet, probably because the fractures are filled with talcy, gougey material which makes the mass quite impervious to water.

At that time a diamond drill hole was started at a point near the southerly side of the zone and drilled northerly through the shear zone. Its width was found to be some 350 to 400 feet. In the drill hole, the ground became increasingly heavy from south to north and considerable difficulty was experienced caused by squeeze on the rods and casing. The most northerly fault zone in the hole was drilled originally without difficulty and the hole reached a point about 30 feet into

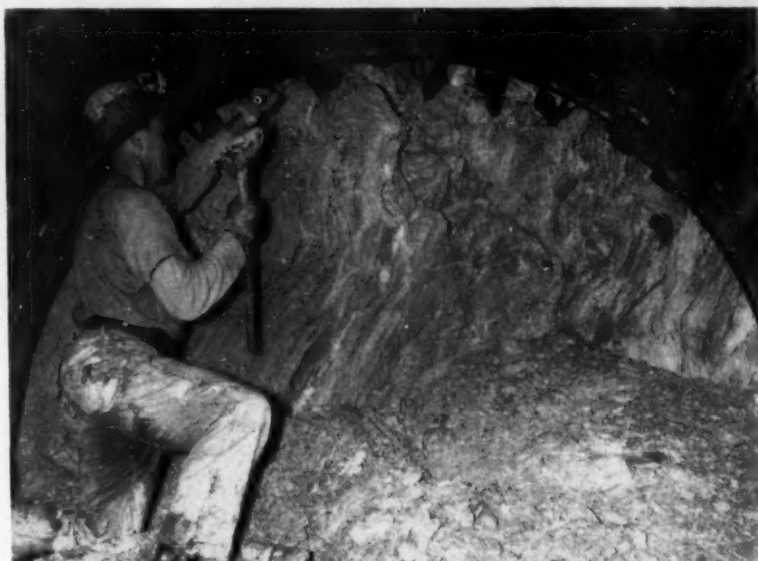
harder ground north of the fault. However, after the gouge became wet from drilling it began to flow out of the hole. Washing only made it worse and the hole was stopped when the rods could no longer be held in the hole with 400 pounds pressure. When the rods were pulled the last time, the gouge from the fault was extruded, sausage-like, from the hole.

Knowing the severe ground conditions which were ahead, a better method of support was obviously necessary. Previous experience had shown that, up to a point, the ground could be rock-bolted and timbered and then

relieved by repair or retimbering. Framed 12- by 12-inch timbering with a sill piece under the track was considered but discarded because of the large excavation necessary and the fact that its strength would still not be sufficient. Reducing the set intervals would have given more strength but a costly repair problem would still have existed.

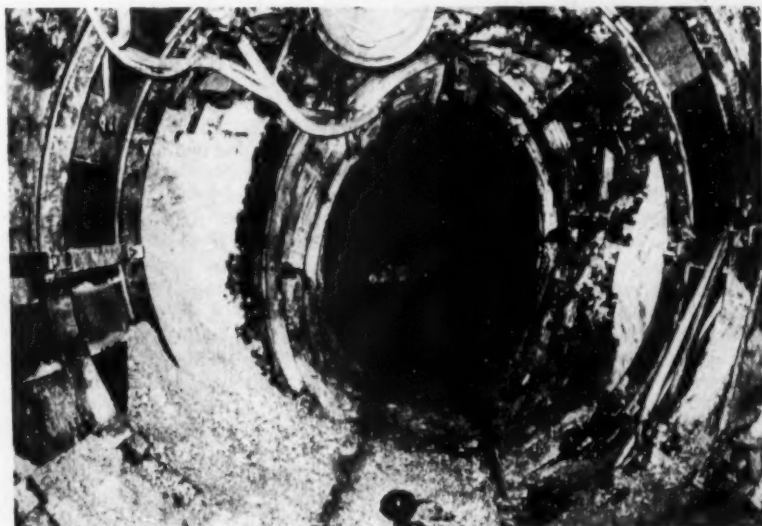
Ground Support By Yielding

Experience with this extremely heavy ground had shown that it could not be held by existing rigid types of support. The best solution appeared



This Heavy Plastic Ground

Crushed Round Steel Sets To Egg Shaped Openings In Background





Broken Squeezed Lagging And

Distorted Circular Rings Made Steel Replacement Mandatory



to lie in a ground support method which would allow yielding, eventually transferring the load from the support to the ground itself in a pressure arch or ring around the crosscut. It had been noted that rock bolted sections of sheared, heavy ground had a "yielding effect," i.e. the ground, even though quite unconsolidated, was held together as a unit by the rock bolts. This gave the cross-section of the opening greater strength and made it possible to hold the crosscut open more successfully with rock bolts than with timber, even though the crosscut decreased in area considerably. The decision was then made to use 8-foot-diameter, 15-pound-per-foot, Bethlehem yieldable steel rings on 4½-foot centers. This particular ring was used because it was readily available without delaying the operation. The 4½-foot spacing was selected because lacing material was available in 5- and 10-foot lengths and it was desired to lap the joints 6 inches rather than butt them.

The last two rings were installed inside of oversize conventional timber sets which had been placed to catch a cave at the cross cut face. This, of course, did not give uniform pressure around the ring sets even after all spaces had been filled with muck or split cedar lacing.

Support Back to Place Rings

To supply temporary support while a ring was being installed and thus prevent caves, the face was spiled ahead of the round to be blasted by

drilling four five, 9-foot long holes in the face at the back with a 2½-inch bit. "U"-shaped loops of ½-inch rod were tack-welded to the underside of the upper quadrant of the last ring. Then 1¼-inch, used, standard pipe was driven into the holes with the drifter on the drill jumbo. A 25-hole, 5-foot round was then drilled and blasted. The round broke to the pipe spiling and the back was thus temporarily supported until the ring set could be installed and laced. This spiling was pulled, when possible, in preparation for placing the back lacing. Usually, the holes squeezed shut around the pipe and it had to be cut off with a hack saw.

This pipe spiling was very successful. However, as the rings yielded later it was found that the weld beads left from the loops welded on the rings for the spiling interfered with the yielding and could cause deformation and failure of the ring. Also, there was a possibility of weakening the manganese-steel rings from the heat of the welds. If the method is used again, a support loop which simply hooks over the top of the ring will be substituted.

Lacing was made by cutting bundles of 4- by 10-inch by 10-foot lagging in half with a chain saw. The lagging was placed tight together with no spaces, completely around the set. The ends were lapped rather than butted because it was felt that there might be enough longitudinal deformation to allow the ends to slip off

the 5-inch width of the rings. An 8-inch standard pipe drainline was installed as a water ditch outside the steel rings. An indication of the tremendous forces brought to bear was shown when this drain line was later found to be crushed flat.

Fill Tight Behind Rings

An Eimco 12-B mucking machine was used to muck out the round. A temporary stull with lacing sometimes had to be placed across the face to prevent its falling out while a set was being installed. Usually, about two 50-cubic-foot cars were hand mucked from below track level to make room for the rings and lacing below the track. This muck was thrown behind the lacing, filling about half the height of the set. At first, it was thought the back and sides of the crosscut would cave and fill the remaining space. At this time, the lacing was strapped onto the set with conventional ¾-inch steel strapping to prevent its being dislodged by the blast. However, the space above the sets did not fill fast enough or tightly enough with the result that the bottom, already in contact with the lacing, heaved excessively. Therefore, the remainder of the sets were chinked tightly with split cedar lacing material. It was found that tight filling was essential to the successful transfer of the load from the ring to the ground in the form of a pressure ring. Open spaces or loose caving ground outside the rings only delayed or made this

No Yield As U Bolts Crush Lagging

Mine Shop Successfully Straightens Bethlehem Steel Archs For Reuse



load transfer impossible. And, of course, if this process is not successful, the pressure continues on the ring sets with eventual distortion and failure.

The 4-inch by 10-inch lacing placed in the bottom was butted and a ¼- by 10- by 20-inch steel plate placed over the joint. This helped hold hand-mucking to a minimum. These bottom lacings were usually placed about 6 inches below grade to compensate for the bottom heave which moved faster than the rest of the set because of the lubricating effect of the drill water and close contact of the lacing with undisturbed ground.

Briefly, the cycle was as follows:

1. Drill 2¼-inch 9-foot-long back holes and place 1¼-inch pipe spiling.
2. Drill and blast 25-hole, 5-foot round.
3. Muck out, support back if necessary, and hand-muck space for bottom lacing of ring set to be installed.
4. Install 8-foot-diameter, 4-quadrant, yieldable steel ring using four, 3-inch channel iron spacer bars. Place 4- by 10-inch 5-foot-long-lacing.
5. Fill wall and back spaces outside the lacing with muck or split cedar lacing.

A weekly record of the movement of the sets was kept as the crosscut progressed. A total of 102 sets were placed over a distance of 453.3 feet. The shear zone in general appeared to get heavier as the crosscut was driven

northeasterly from hanging wall to footwall. Measurements of the yielding of the first 52 sets showed the greatest movement during the first week after installation. Then the yielding slowed down though it continued for six weeks in this area and is still continuing in some portions of the zone.

Beyond this point, the bedding or fracturing of the shear turned so as to be nearly parallel in strike to the direction of the crosscut. This caused a diagonal pressure, perpendicular to the shear planes, to bear on the sets, resulting in unequal yielding of the quadrants. The rings yielded to an oval shape with the axes at about 45° to the horizontal. All the U-bolts holding the quadrants of the sets together had been tightened with an impact wrench which gave a torque wrench test of 200 pounds per square inch. Later checks on these bolts showed that they did not maintain the original tension as set. A variation of as much as 100 pounds per square inch either way was shown in as short a time as one day. This was partially due to the fact that the U-bolts were tightly enclosed by the lacing. This interfered with their proper yielding, causing a drag on the U-bolts which broke more than 100 of them. These were replaced by two J-bolts since there was insufficient room to place a new U-bolt.

Experimenting with the use of different tensions on the U-bolts seemed to have little effect as long as the drag

exerted by the lacing interfered so quickly. To overcome this problem a ½- by 2½- by 11-inch mild steel strap was welded on each side between the two U-bolts which make up each quadrant joint. This made the U-bolts as each joint act as a unit and caused them to remain perpendicular to the rings regardless of drag. This, in turn, allowed the bolt tension to be set and maintained as desired and contributes materially to uniform yielding of the rings.

Replace Deformed Sets

After a set had yielded or been deformed from an 8-foot, inside-diameter to a 6-foot-diameter or less, it became necessary to remove and replace it with a full-size 8-foot diameter ring. As may be expected there was considerable apprehension concerning the removal of one of these sets under such evident pressure. When a set was struck with a hammer to cause it to yield, a report similar to a pistol being fired usually resulted. However, after the first two badly deformed sets were removed, it was found that the lacing was compressed somewhat like a barrel and had to be blasted out. When this lacing was removed, it was observed that the sheared wall materials showed definite evidence of the formation of a pressure arch or ring about the crosscut. The sheared material could be dug out with a pick but no longer ran like gravel.

Replacement of these deformed sets

was carried forward where necessary. It appeared for a considerable period of time that the ground, once relieved in this manner, no longer moved appreciably and that the repair sets would hold the ground satisfactorily. In areas where the pressure ring established by the first sets was not materially disturbed these repair sets held, but in others the arch was lost. In these and other portions where the ground continually closed in, the rings were doubled up to 2-foot 3-inch centers. To date these doubled-up sets are holding the ground satisfactorily and at present any repair necessary is

done on 2-foot 3-inch centers.

Up to the present time, 102 sets on 4½ foot centers have been installed for a total distance of 453.3 feet. A total of 40 distorted sets have been straightened and replaced. Fourteen of these replaced sets were installed on 2-foot 3-inch centers for a total of 47 rings replaced. For the 453.3 feet of advance and repair, the direct labor cost was \$38.59 per foot and material \$45.58 per foot for a total of \$84.17 per foot.

On the footwall side of the shear zone, the crosscut passed into a 60-foot-wide band of silicified Wallace

formation and then into St. Regis formation. The crosscut is now being supported by rock bolting.

Heavy Not Swelling Ground

At one stage of the repair of the steel rings, an investigation was made to determine whether or not this soft, sheared material might actually be what is known as swelling ground. Tests of the broken material in open end glass tubes showed the rock to be nearly impervious to water due to the talcy, sericitic nature of the fines. No evidence of swelling was noted. It follows then that the track heaving in the crosscut bottom and other areas was probably caused principally by the lubricating action of the water plus the existing ground pressure.

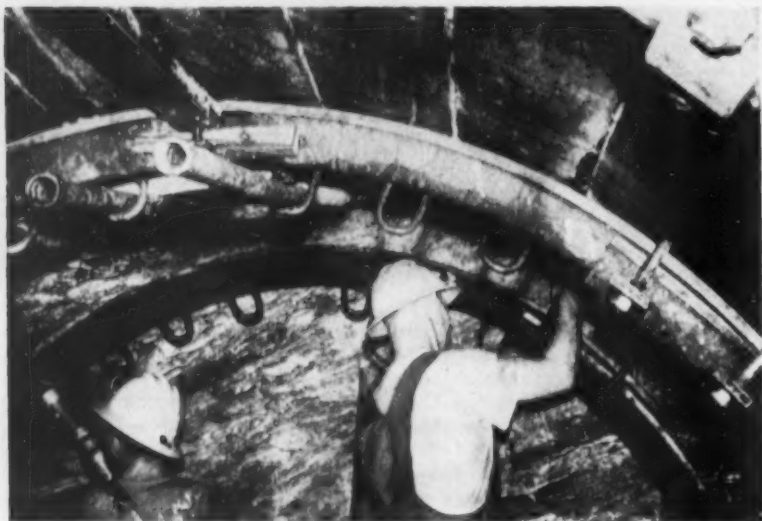
With the thought of keeping the drilling water out of the ground as much as possible, a gunite machine was tested. This did not prove to be satisfactory as the rock was too loose and broken to hold the gunite. The air blast from the machine dislodged considerable rock from the walls also and the cement gun, when used in such a confined place, created entirely too much dust and fog.

The experience which has been gained to this date indicates that replacement of the sets might have been avoided by either reducing the set interval as has now been done or by increasing the weight of the steel section. It is also apparent that if the original sets had been of a larger diameter, say 10 feet, sufficient yielding space would have been available to transfer the ground pressure from the rings to the pressure arch before the inside diameter became too small for equipment to pass. The 4-inch lagging thickness proved to be satisfactory. Although the lagging was broken in many places, no set ever had to be repaired because of lagging failure. It is the writer's opinion that the 15-pound steel ring section has sufficient strength if a large enough diameter is used as mentioned above. Probably, the cost of the heavier 21-pound section would not be justified for this ground.

Repair of the deformed steel rings has been accomplished in the Hecla Shop by use of male and female dies made of a portion of one of the rings. Since these rings are made of a medium carbon steel, they cannot be heated to more than 700° F. without weakening. Most of them can be straightened cold using the die and an air hammer.

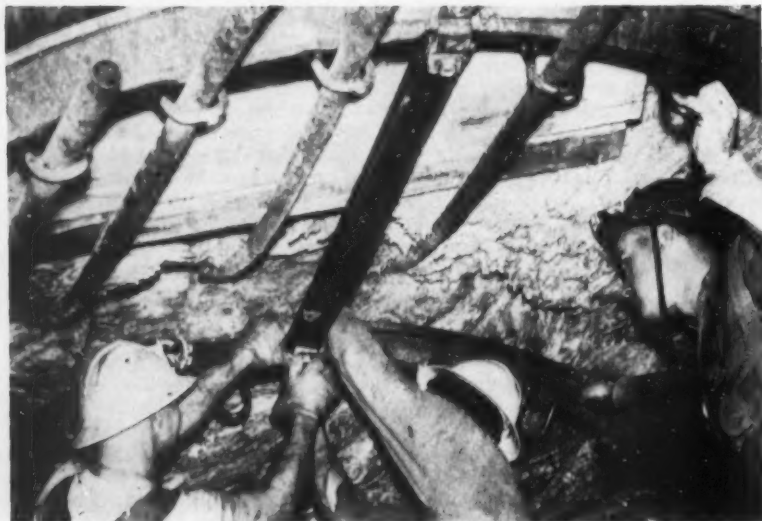
The Bethlehem yieldable steel ring has been successfully used at the Silver Mountain Exploration Project to support ground which many experienced mining men state is the heaviest they have seen.

THE END.



Miners Assemble The Steel Ring

Working Under Pipe Spiling Driven Into Long Drill Holes





SPECIAL REPORT

From University of Arizona Symposium On . . .

Applications of Fluid Bed Reactors

Forty-one metallurgists from the United States and Canada turned out for a one-week educational program on fluid bed reactors sponsored by the University of Arizona at Tucson during the week of February 23. They were joined on March 2 and 3 by another 60 to 70 delegates who came to hear eight papers delivered on this subject by leading authorities in the field.

Those who attended the 5-day educational program were well equipped to get the maximum value from the formal symposium and a tour of Kennecott Copper Company's reactor at Hayden, Arizona, which followed. Professor Sigmund Smith, who developed, planned, and directed the project, had observed that a large percentage of the audiences at many conventions and meetings devoted to highly technical subjects were failing to fully grasp ideas that the speakers were trying to get across. Professor Smith decided to do his best to correct this situation in the symposium which he planned, and thus the educational program was born.

The particular manner in which the University of Arizona program was developed is believed to represent the first approach of this type to the handling of a specialized technical subject in the mining industry. The educational program was designed on the professional level for engineers who control or who are directly and indirectly connected with the operation of fluidizing reactors.

Many of the "students" were experts in their own right since they were operating or building reactors. They came to find out answers to specific problems. Other were there for the purpose of evaluating the application fluid bed reactors to treatment problems at their own plants. Following

are some specific points on which discussion centered.

SIZE: What is the relationship between height and diameter of a fluid bed reactor? The answer is that 10 feet is about the minimum height of a reactor that can be used for a 3- to 5-foot-deep bed. Jetting of the bed will probably take place in a reactor less than 10 feet in height, regardless of the diameter. The diameter is determined by the retention time, feed rates, bed height, and gas velocity required to carry out the desired physical or chemical reaction.

FREEZING: In handling sulphides how can freezing of the bed be detected and prevented? About the only available clue is erratic temperature readings from several thermocouple taps in the bed. If a hot spot develops in a sulphide bed, prompt action is necessary in order to save the bed from completely sintering and freezing tight. If it happens, you have no recourse but to cool the reactor and dig the bed out.

PARTICLE SIZE: What are the finest particle sizes that can be fluidized? There is no single answer to this question. Too much depends on whether the reactions are exothermic and drive themselves or whether they are endothermic and require heat. Too much depends on many other variables too numerous to mention. Under some conditions the reactor may tend to act as an air classifier. For extremely fine sizes, the addition of a coarse inert material (silica sand in some instances) may help to keep the bed in fluid condition. With extremely fine feed, flash roasting of sulphides can become a problem. With some fines undergoing endothermic reactions, it may be possible to obtain a surface fusion and a beneficial plastering of fines into larger particles in a fluid bed.



PROFESSOR SMITH starts educational program with first order reactor equation.

Special feed guns reportedly have been developed by Sherritt Gordon Mines Ltd. to feed minus-325-mesh sulphide fines to fluid bed reactors.

PARTIAL ROASTING: The copper people were particularly interested in this. They wanted to know if copper sulphides had been partially roasted on a commercial basis for the production of acid from the gas, while yielding a calcine with a suitable sulphur content for matte roasting. The answer to this is that it is going to be done commercially in a plant under construction at International Nickel Company at Sudbury, Ontario. This plant is being designed to handle 2,500 tons-per-day of copper-nickel concentrate and flux. It will include three, 15-foot-diameter, Dorco Fluosolids reactors.

SELECTIVE ROASTING: This drew as much interest as anything else during the educational program. The possibilities are boundless if you let the imagination run. Complex ores, for instance copper-zinc, are susceptible to separation by selective roasting which is possible only through the precise temperature controls offered by fluid bed reactors. By first selectively roasting, then recovering, one metal, followed by a roast of the residue to recover another metal, it may be possible to realize many smelting advantages.

SLUGGING: This is a general term which denotes extreme vibrations, pulsations, or violent rolling of beds. Little is known of the causes or the solutions. Some people hold a theory that it may result from formation of large air bubbles under a "pancaked" layer which comprises a portion of the bed, followed by sudden release of the air to another higher, pancaked layer of bed. About all that can be said is that this phenomena has been noted in a few instances and its cause is not clearly understood.

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TEST REACTORS: Many metallurgists departed from Tucson with the conviction that if you have adequate sample material and enough money available, you are better off with a 12-inch reactor rather than a 4-inch reactor. This is not meant to imply that you can't get reliable results in a 4-inch reactor because you can. But your difficulties (freezing, plugging, and heat losses) are compounded in the smaller reactor. In other words, the 12-inch reactor will probably yield more trouble-free operation.

In the following pages we present abstracts of the papers which seemed to provoke the most discussion, together with significant comments which were noted during the meetings.

Principles of Fluidization

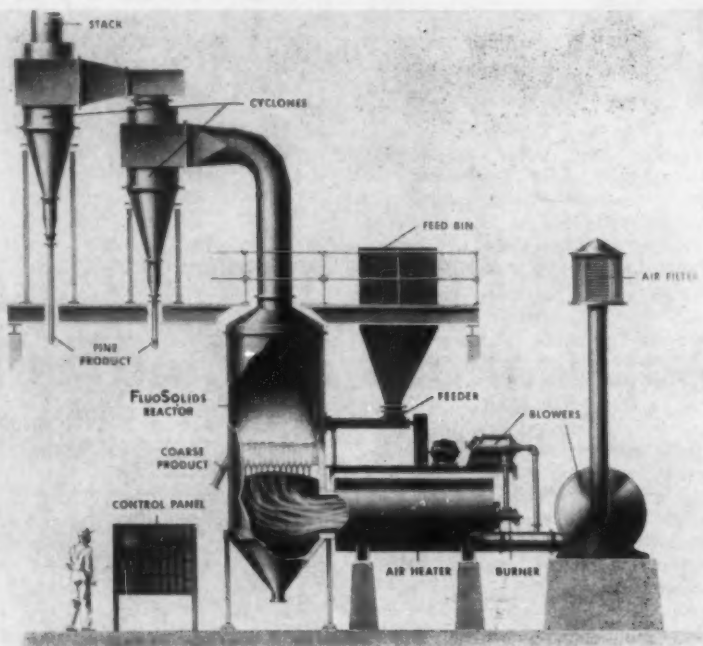
In its simplest terms, fluidization is the suspension of solid particles in an upwardly moving stream of gas. The resulting, violently agitated, dense mass behaves much like a liquid and will, in fact, exhibit many of the characteristics of a fluid, such as exertion of a hydrostatic head and maintenance of its own level. To be suspended, solid particles must be finer than a limiting size which is determined both by gas velocities employed and by the specific gravity of the solids.

Consistency of the fluidized mass is extremely uniform as to particle size, temperature, and chemical composition. At all times, each individual particle is surrounded by a film of gas. As a result, transfer of heat between solids and gases is extremely rapid, facilitating close temperature control. And because of the intense gaseous-solids contact, chemical reactions are instantaneous.

During the past 15 years the fluidized bed has developed from a laboratory curiosity to a position of considerable importance in extractive metallurgy where it is useful for developing gas-solids contacting for physical and chemical interaction systems.

Fluidization principles date back in history, but it only became a commercial unit operation during the early 1940's as the result of intensive development work by Esso Research & Engineering Company in the petroleum field. In 1944 Dorr-Oliver Inc. obtained a license from Esso for development of the unit process in non-petroleum, non-catalytic fields.

Dorrco FluoSolids Reactor



GLOSSARY OF FLUIDIZATION TERMS

- Black roast**—a term used in the roasting of iron sulphides to denote conversion of iron to the black, or magnetite (Fe_3O_4) form.
- Constriction plate**—the refractory, steel, or castable arch which separates the reactor proper from the windbox below.
- Cyclones**—the primary means of recovering dry, entrained solids from reactor exhaust gases.
- Dead roast**—one in which only 100 percent of the theoretical air requirements are allowed to react with the feed. As a result, products are completely oxidized, but not sulphated to any degree.
- Endothermic reaction**—one which requires the addition of heat in order to proceed.
- Exothermic reaction**—one which liberates heat once the desired temperature of operation has been attained.
- FluoSolids system**—a registered trademark for a series of equipment units designed to carry out the unit operation of fluidization. The complete system includes reactor, feed and dust collection systems, instruments and control panel, air blower and compressor, ducts, and various other auxiliaries.
- Heat balance**—a thermodynamic calculation involving heats of reaction to determine the quantity of heat which must be added as fuel in an endothermic reaction or the heat which must be removed from the reactor by some means in an exothermic reaction. This calculation takes into account the sensible heat of all products as well as any expected radiation losses.
- Overflow product**—that coarse portion of the treated solids which are discharged from the fluid bed by gravity, or other means, rather than recovered in the cyclones.
- Partial roast**—one in which insufficient air is provided to carry the chemical reactions involved to completion, thus producing a partially roasted product.
- Radiation loss**—the heat values lost from the reactor and ducts by radiation as opposed to that heat carried out by the exhaust gases and product solids.
- Red roast**—a term used in the roasting of iron sulphides to denote conversion of iron to the red, or hematite, (Fe_2O_3) form.
- Space rate**—the actual gas velocity through the fluid bed at operating temperature and pressure.
- Sulphating roast**—one in which a substantial excess of air is available so as to provide an opportunity for sulphur values in the feed to be recombined in the calcine as sulphates.
- Tuyeres**—orifices in the constriction plate through which fluidizing air is distributed across the entire cross-sectional area of the reactor.
- Unit Capacity**—the amount of solids which can be treated in the reactor expressed in tons of dry feed per day per square foot of horizontal cross-sectional area of the reactor.

To Select a Reactor Use Systems Engineering

By **JOSEPH F. SKELLY**
M. W. Kellogg Company

In considering reactor selection problems, the systems engineer begins by examining the entire mineral handling installation of which the reactor is to be a part.

Those who supply raw materials (ores and fuels) to the system wish to be able to supply materials of variable composition and physical properties at a constant rate. While the miner and the coal dealer would like to pass on their raw materials with the changeable characteristics found as they work through natural deposits, they would like to be able to require the system to accept its raw materials at a steady, predictable, guaranteed rate. On the other hand, the users of the materials which are prepared by the system have exactly the opposite desires. They would like the properties, both chemical and physical, to be very uniform at all times in spite of the fact that the users wish to be able to consume these products at a variable rate. It becomes important, therefore, for our system and its reactor to be capable of accepting raw materials of variable properties while still retaining the ability to produce a relatively uniform product. The conflicting rate requirements of the raw material suppliers and the product users can be accommodated to some extent in the design of a flexible process but it probably will be necessary to rely upon surge capacity (i.e. stockpiles and warehouses) for most of the rate adjustments.

Waste disposal problems, both from the standpoint of public nuisance and from the need to prevent the loss of valuable product, can often play an important part in helping to choose the best reactor for a given mineral processing system. It can be very instructive to consider competing reactor types as though they were simply devices for the production of waste products rather than marketable products.

Energy requirements play an important part in determining the operating cost of any process system, and in making this appraisal it is necessary to take account of the fact that energy

can, of course, be brought into the plant in a variety of forms. In considering promotional material about new reactor schemes we must always be on guard against phenomenally low energy requirements which turn out to be statements of the need for one particular kind of energy only, while other forms of energy also needed in the process are not mentioned. The iron ore reduction field at the present time is frequently greeted with statements of this sort which would make the uninitiated think that the first law of thermodynamics no longer applies.

The foregoing paragraphs constitute a brief discussion of the subject which systems engineers describe as "exterior system design."

In general, any processing system for the handling of mineral or chemical raw materials consists of a network of alternating reaction zones and separation zones. In the reaction zone the material undergoes rather extensive chemical or physical changes.

Considering now a chemical reaction zone, the feed material usually requires the input of energy to it before it is ready to participate in the desired chemical reaction. This energy will be partly in the form of mechanical energy required for transporting or compressing the feed, but mostly it will be in the form of heat energy needed to bring the feed up to some desired high temperature. The products leaving such a reaction zone are therefore also at a high temperature and need to be cooled down in most cases before they can enter the succeeding separation zone. The reaction zone, therefore, is preceded by an energy input stage and followed by an energy withdrawal stage. If our system is not to be burdened with excessive energy consumption costs, we will be strongly attracted toward reaction systems which provide means for exchanging energy between the cooling down of the product and the heating up of the feed. From this point of view it will be immediately apparent that certain reactor types enjoy rather fundamental advantages although it is generally true that any reactor system can be equipped with reasonably satisfactory heat exchange devices. In comparing competing claims for energy efficiency of various

reactor types, it will usually be very helpful to inquire into the heat exchange facilities used in the cases under study. In many cases it will turn out that reduced energy requirements in a new reactor design come about simply because the new design contains heat exchange facilities which are superior to those available in older types of apparatus.

The relative importance of temperature control in the zone has a powerful influence upon the choice of reactor type. In general, the fluidized bed provides for much more uniform temperature during reaction than do the fixed bed, shaft, and rotary kiln designs. One of the questions which confronts the systems engineer is to determine the relative value of temperature control in the reaction at hand because there are some unavoidable disadvantages associated with the fluidized powder procedure.

Temperature control is usually very important in cases where there are competing reactions which can take place between the various chemical substances present in the system. This is a particularly serious matter in the design of reaction systems for carrying out many processes in the field of organic chemistry. Here the designer wishes to subdue the formation of unwanted byproducts and to prevent deterioration of catalysts which are usually damaged by high temperatures. In metallurgical processes the problem of catalyst damage is usually not present, but its place is taken by the need to avoid temperatures above those at which the reactants begin to attack the materials of construction used in the reaction chamber. Some success has been achieved in the maintenance of close temperature control in rotary kiln reactors (see for example, the R-N process for the reduction of iron ore), but in general it is certainly easier to control temperature in the fluidized bed than in the other types of reactors. This last statement must be qualified by the observation that the superiority of the fluidized bed exists only so long as the desired operating temperature is below the fusion point of any of the solids present in the system. It appears to be difficult to maintain a fluidized process when the solids are at temperatures close to the melting point. In designing the reactor component of any chemical processing system, it is important to consider the effect of reactor type on the chemical potential which will make the desired reaction go forward. The chemical kinetics literature makes it abundantly clear that this chemical potential is usually greatest when a reactor permits the counter-current flow of reacting materials. When a reactor is so de-

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signed that there is an intimate mixture of the reacting substances with comparatively uniform composition throughout the reaction zone, the chemical potential is generally at a minimum. Since the size, and therefore the cost, of the reactor will usually be inversely proportional to the chemical driving force, we find that counter-current reactors are usually cheaper than continuous stirred tank reactors. The fluidized bed is a continuous stirred tank reactor (in the jargon of the chemical kinetics experts) and for this reason will be larger for a given chemical job than the counter current reactor operating at the same temperature. This additional reactor cost is often not too significant in evaluating a reactor type because of the fact that reactor cost is often a relatively small part of the total system, but it should

nevertheless be evaluated as part of an orderly system design study.

Some aspects of the waste disposal problem have an influence upon the choice of reactor type. In general, the more finely divided are the solid particles in the system, the more difficult it will be to recover these solids and prevent their eventual discharge into the atmosphere. When we handle dusts which are either very valuable or very obnoxious this question may play a major part in the selection of the best reaction component. Fixed bed and shaft reactors, which must be charged with lump or pelletized feed, will usually offer fewer dust recovery problems than will the fluidized power reactor which must necessarily be supplied with finely divided feed particles. The rotary kiln, which produces fines through mechanical attrition, usually lies between the fluidized bed and the fixed bed in the appraisal of dust collection difficulties.

An important group of components

in the interior design of a metallurgical processing system is that concerned with materials handling apparatus. The importance of this consideration increases as the size of the plant increases. Fixed bed reactors are obviously intermittent in operation and, therefore, cannot be directly connected to continuous materials handling machinery. The shaft, rotary kiln, and fluidized bed reactors are more susceptible to continuous feed introduction and product withdrawal—a factor which substantially increases their attractiveness. However, the importance of this element is greatly diminished if the reactor has to operate at relatively high pressure. All high pressure mineral processing reactors must be supplied by intermittent feed conveying equipment because our component engineers have as yet failed to perfect a continuous pumping device capable of moving large quantities of solids through a big pressure differential.

Who Attended Educational Program

• **George J. Allen**—Kennecott Copper Corporation, Ray Mines Division, "We have a 22-foot diameter reactor to make acid for the LPF circuit and a calcine which is reduced to sponge iron. The sponge iron is also necessary for the LPF circuit."

• **Henry Allen**—assistant superintendent, International Smelting and Refining Company, Miami, "We don't have a reactor, but I've been hearing so much about how the fluid bed reactors are going to put the smelters out of business that I decided to come down here and find out something about the process. If we can't lick them we had better join them."

• **R. L. Bird**—research metallurgist, The Bunker Hill Company, Kellogg, Idaho, "We have flash roasters at our electrolytic zinc plant near Kellogg, but we are interested in the fluid bed principle and want to find out more about how the process might be applied at our plant."

• **Jim Blair**—metallurgist, Tennessee Copper Company, Copperhill, "We make considerable quantities of sulphuric acid from pyrrhotite ore by recovering SO₂ from semi flash roasters so we have a natural interest in the fluid bed furnaces. We are currently installing a 1-foot diameter Dorcco Fluosolids reactor and I want to find out how to run the thing."

• **Donald R. Brutvan**—Metals Research Laboratory, Union Carbide Metals Company, Niagara Falls, "We are interested in fluid bed reactors as a research tool."

• **Robert E. Cech**—metallurgist, General Electric, Schenectady, "We have a research reactor of 2¼-inch inside diameter."

• **Nell Colvin**—Sherritt Gordon Mines, Fort Saskatchewan, Alberta, Canada, "Our plant is treating nickel-cobalt ores using an ammonia pressure leach. Recently we have become interested in roasting low grade ore and tailing residue to recover additional nickel-cobalt."

• **George Critchton**—Fuller Company, Catasauqua, Pennsylvania, "We are clinkering Portland cement in an 8-foot diameter reactor by plastering extreme fines to sticky, surface-sintered, larger particles. Our dry feed is 20 percent minus-5-microns and 90 percent minus-200-mesh."

• **Stanley H. Dayton**—assistant editor, Mining World, San Francisco, "I've gone back to College to keep abreast of latest metallurgical techniques so I can do a better job reporting and interpreting for Mining World readers."

• **Henry Dolezal**—U. S. Bureau of Mines Experiment Station, Boulder City, "We are building a 6-inch fluid bed reactor and it is now about 75 percent complete. Our primary interest is in conducting chloridizing roasts on titanium."

• **Joseph Herz**—California Portland Cement Company, Colton, "I came down here to try to get some information and talk to people who have had experience on roasting and calcining at temperatures of 2,500° F. So far I haven't learned very much about this specific point."

• **A. W. Jeffer**—research metallurgist, Shattuck Denn Mining Corp., Humboldt, "I wanted to find out about the possibilities for using the fluid bed reactor in recovery of both gold and SO₂."

• **H. Kenworthy**—Engineer-in-charge-Pyrometallurgy, U. S. Bureau of Mines (Missouri), "Our interest is in the application of the reactor to sphalerite concentrates."

• **A. H. Kinniberg**—Phelps Dodge Corporation, Morenci, "I'm interested in learning if any work has been done on partial roasting of copper concentrates for recovery of sulphuric acid."

• **Eugene A. Lang**—National Lead Company, Fredericktown, "We wanted to find out about selective sulphate roasting of cobalt-nickel ores and concentrates."

• **Don McKay**—Noranda Mines, Quebec, Ontario, Canada, "We don't have any fluid bed reactors, but we are interested in all aspects of selective sulphate roasting of copper-zinc concentrates similar to what is being done by Dow Mining Company in Japan."

• **W. L. McMorris, Jr.**—general manager, Coal Preparation & Distribution, U. S. Steel, Pittsburgh, "Our interest is in the use of the reactors for coal drying."

• **M. L. McMorris, III**—Columbia Geneva Steel, "Our interest is in coal drying in size ranges from 1½ to 0 inches."

• **Mark Nesbitt**—Anaconda Company, Weed Heights, "We have four Dorcco Fluosolids reactors making SO₂ for our acid plant from a siliceous elemental sulphur ore. Since our sulphur reserves are not quite adequate to meet the acid requirements for our copper oxide ore body, we have been augmenting the feed to our roasters with a high grade (approximately 48 percent sulphur) pyrite ore obtained from Mountain Copper Company. We are mixing about 10 percent pyrite with the siliceous sulphur ore. Our reactors were built to operate at a

Fluosolids Roasting at Weed Heights

By HENRY R. BURCH
The Anaconda Company
Weed Heights, Nevada

The Anaconda Company operates four fluidizing reactors at its oxide copper leaching operations at Weed Heights, Nevada. The reactors were designed to furnish sulphur dioxide to a 450 ton acid plant by roasting sulphur ore mined at Anaconda's Leviathan mine. In 1958 this ore averaged 29 percent sulphur and ranged from 27 to 33 percent.

Originally ore was ground minus-10-mesh in rod mills before furnacing. Experience showed that a much coarser ore could be roasted. However, difficulty in sluicing calcines made it necessary to grind so that no more than 25 percent is plus-10-mesh.

The heat from the burning sulphur

in the ore is more than sufficient to maintain temperatures in the reactors. Water is used under normal conditions to hold temperatures to the desired operating range. The dome sprays control bed and free-board temperature. However, the moisture content of the ore being fed to the reactor has some effect, in particular on bed temperature. By constant attention to these items the desired operating temperature can be maintained.

During a normal operating day about 575 dry tons of sulphur ore is introduced into the Fluosolids Plant. This amount of ore will make approximately 400 tons of calcines of which 200 tons will enter the calcine launder from the reactor bed drains. The remaining 200 tons must be collected and disposed of in the dust collection system. About 24 tons will be collected

in the spray cooler, 24 tons in the transfer chamber, 120 tons in the first cyclone, 12 tons in the second cyclone and 4 tons in the third cyclone. The remaining 16 tons will enter the 5 foot gas collection flue and pass into the Peabody Scrubber and Acid Mist Cottrells where all of the dust except about 20 pounds will be removed from the gas stream.

The reactors are normally operated continuously for about 12 months without major repairs. Since 4 reactor trains are available and only 3 are required for operation, one train can be set aside for maintenance and repair at all times.

Throughout the operation of the Fluosolids plant the percentage of extraction of sulphur from the sulphur ore feed to the reactors has been 98.08 percent.

Why They Were There

temperature of about 1,200° F. Since the calorific power of pyrite is greater than for elemental sulphur we have encountered a temperature control problem and at 1,500° we can get a slagging condition in the bed."

• A. F. Nielsen—Cerro de Pasco Corporation, New York, "We are roasting zinc concentrate pellets."

• C. M. Paden—research metallurgist, American Zinc Company of Illinois, East St. Louis, "We are interested in the fluid bed technique in connection with the production of ultra high purity products."

• Wes Parker—Inspiration Consolidated Copper Company, "I wanted to find out about the roasting of copper sulphide concentrates for leaching purposes. We use acid for leaching of copper oxides."

• J. Patton—general surface foreman, Kennecott Copper Corporation, Ray Mines Division, "We have a paper that will be delivered at the symposium so I'm not going to say very much about our installation right now. We hope you enjoy the field trip to our plant."

• G. Edward Peters—National Lead Company, Fredricktown, "I wanted to get all the information I could on sulphate roasting for copper-nickel-cobalt systems. We can get good water extraction for copper-cobalt, but we have a problem with nickel."

• Charles Prasky—chemist, U. S. Bureau of Mines, Minneapolis, "We have purchased a 4-inch reactor to conduct tests on reducing roasts for non-magnetic taconites. We also want to study the possibility of sulphatizing roasts to solubilize Cuyuna range manganese, and compare the results with data we have obtained on this by using a shaft furnace."

• John Reynolds—Stauffer Chemical Company, Richmond, California, "We are presently installing a Dorco Fluosolids reactor, 12 feet in diameter, to recover SO₂ for our acid plant from Mountain Copper pyrite ore. We are utilizing an old Herreschoff shell for the fluid bed reactor."

• Robert T. Sanden—Un'on Carb'de Metals, Niagara Falls, "We have a 4-inch reactor and I wanted to get some information on the application of the fluid bed reactors to fines."

• Fred Smithmeyer—University of Kansas, I've been talking up the fluid bed reactor and thought I should learn some additional details."

• A. Starlipper—metallurgist, U. S. Bureau of Mines

(Missouri), "We are interested in the application of the reactor for possible germanium and cadmium recovery."

• Robert J. C. Tait—Giant Yellowknife Gold Mines, Northwest Territories, Canada, "We have a refractory gold-silver ore that is complicated by the presence of members of the antimonial family. Roasting of flotation concentrates has proved to be most practical method for improving gold recovery by cyanidation. Less than 1/3 of our gold is recoverable by direct cyanidation. At present we have a two-stage roasting system in Dorco Fluosolids reactors."

• Don Taylor—U. S. Bureau of Mines, Boulder City, "Our 6-inch reactor is under construction and, of course, Mr. Dolezal has already pointed out that we are interested in chloridizing titanium ores and slags. We are extremely interested in the various materials available for construction of reactors."

• W. J. Trepp—assistant manager, mining operations, General Chemical Division, Allied Chemical & Dye Corp., "We are calcining fluorspar in a fluid bed reactor. For our particular problem we had to reach 1,300° F. for sulphur removal from the system. We could only go up to 1,250° F. by rotary kiln because of an extreme balling and nodulizing condition. We can reach 1,400° in our reactor before we freeze the bed."

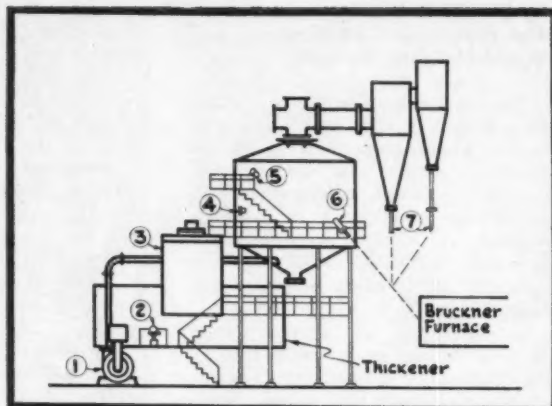
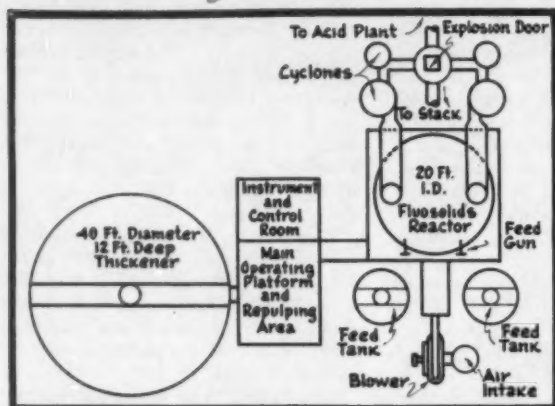
• Howard W. Walker—metallurgist, American Smelting & Refining Company, Silver Bell, "We experience a loss of copper in a middling product and wanted to consider the possibility of sulphatizing this material to recover the copper."

• W. W. Walker—Hughes Aircraft Company, Tucson, "I'm here as a matter of general interest only. Don't get the idea that Hughes Aircraft is interested in this."

• Mr. Wright—Campbell Red Lake Mines, Ltd., Balmertown, Ontario, Canada, "We have two-stage roasters."

• Mr. Wizer—American Telephone and Telegraph Company, used to be a metallurgist and came to meeting for interest only. "AT&T has no plans for a reactor."

• Others in attendance at the symposium were: A. Dresher, Lone Star Steel Company, Lone Star, Texas; George C. Beals, Kennecott Copper Corporation, Chino Mines Division, Hurley, New Mexico; W. J. Bennett, Kennecott's Chino Mines; Newlin Nichols, Wyandotte Chemical Corporation; and Ray Wells, U. S. Bureau of Mines.



Pyrite Treated in Kennecott Reactor

By HENRY W. FRANZ
Kennecott Copper Corporation
Hayden, Arizona

Several years ago the Ray Mines Division of Kennecott Copper Corporation at Ray, Arizona was faced with the necessity for recovering more copper from the complex ores which contained an increasing amount of non-sulphide copper.

The Research Center of Kennecott's Western Mining Divisions was assigned this problem. As a result of intensive laboratory and pilot plant investigations, a modified leaching, precipitation, and flotation (LPF) process was developed and installed in the Ray concentrator at Hayden. The use of sponge iron produced from pyrite as the precipitant for the dissolved non-sulfide copper is essential to this process.

At Hayden where Ray ore is milled a fluidizing reactor is used as one step in the production of sponge iron from pyrite and for the production of strong sulphur dioxide gas for sulphuric acid manufacture. Sulphuric acid is also essential to the LPF process. The final reduction to sponge iron is accomplished in two parallel Bruckner furnaces which are directly fed by hot calcines from the fluidizing reactor.

The fluidizing reactor was chosen for Hayden since the reactor could be fed with a pyrite slurry, a strong SO_2 gas could be produced, hot calcines could be discharged directly into the reducing furnaces, the reactor could be controlled by relatively simple instrumentation, and could be operated by non-technical personnel. The fluidizing reactor offers extreme flexi-

bility as regards feed input. The reactor can be operated at 40 percent capacity and will still give good results in gas strength and in complete roasting or elimination of sulphur.

The reactor at Hayden is normally autogeneous in converting iron pyrite slurry to hot hematite calcine. A portion of the reactor sulphur gases is sent to the contact acid plant for conversion to commercial sulphuric acid.

Raw feed material, mill pyrite slurry, is pumped into the 40-foot diameter thickener. As there are scheduled periods in which no mill pyrite is produced, a system of repulping stockpiled dry pyrite must be used.

The underflow from the thickener is normally pumped into one of the agitated feed tanks. The repulped slurry from stockpile can also be sent directly to one of two 12-foot diameter agitated feed tanks. Each feed tank has an air actuated pump which either recirculates continuously the feed within the tank itself or to the thickener; or the slurry can be pumped directly into the reactor approximately one foot above the normal bed level. Reinforced rubber hose is used for the pump discharge piping to provide the flexibility in transporting the slurry. There are two feed nozzles into the side of the reactor, one connected to each tank, but only one feed nozzle and tank is "on feed" at any one time. The feed nozzle has air connections which permit atomization of the slurry as it enters the reactor. A water line is also connected to each feed gun for temperature regulation. The water is also used when it is necessary to clean the nozzles or feed guns.

A low pressure, 300 horsepower,

12,000 cubic foot per minute centrifugal blower is used to supply air for fluidization and to support the reaction of converting pyrite to hematite. Filters placed in the air intake line insure that reasonably clean air is used. The amount of air used is dependent upon the feed rate and the grade of pyrite and is determined by the reactor bed temperature and by the amount of excess oxygen leaving in the gas stream.

By a system of stainless steel gravity discharge pipes the hot calcines from the reactor bed overflow and the hot suspended solids removed by the cyclones are introduced into the Bruckner furnace. Of the total calcine feed to the furnace, approximately 15 percent comes from the bed overflow and 85 percent from the cyclone collection system. This percentage is not fixed but depends upon the particle sizing of the pyrite feed. The bed overflow percentage would increase if the pyrite feed were to contain larger sized particles. Since the hot calcines from each cyclone bank and each bed overflow discharge into one of two Bruckner furnaces, when only one furnace is being operated, the other cyclone bank and bed overflow is made inoperative by the insertion of blanks in the gas ducts and discharge pipes.

At present the reactor is operated by a combination of both manual and automatic controls. The pulp density of the pyrite slurry at the several points is determined manually by means of pulp balances. The amount of fluidizing reactor air is selected manually and is controlled automatically at the pre-selected level.

For start up purposes after prolonged inoperative periods, two aux-

iliary automatic natural gas burners are used to bring the reactor up to operating temperatures. These burners and their controls are located on a separate operating platform near the top of the reactor. If the reactor has been operated for at least one hour in every 24, the reactor temperatures can be maintained for some time. The reactor can be completely down for about 72 hours and can still be started without using the auxiliary burners. Low pressure combustion air for these burners is provided by the main blower.

The Ray pyrite has an iron content varying from 34 to 46 percent, the average being approximately 38 percent total iron, 2 percent copper, and 10 percent insoluble matter. The original design capacity of this reactor was 180 tons per day of dry pyrite. Reactor bed temperatures are held usually at approximately 1,600° F. and temperatures of at least 1,350° F. are required before the reactor can be started on pyrite feed. With but one Bruckner furnace operating, the reactor feed rate is normally held between 3.0 and 3.5 tons per hour depending upon the grade of pyrite being used and the gas demands of the acid plant. When the feed rate is held at 3.0 tons per hour and with one bank of cyclones operating, approximately 1.7 tons per hour of hot calcines are discharged into the Bruckner furnace.

At present the feed rate is determined by measuring the decrease in slurry level in the tank being used as the feed tank. This information, when

Sample Copy Daily Log Sheet For Fluidizing Reactor at Hayden

Instrument	Range	Reactor readings	Reactor readings
		when one Bruckner is operating	when two Bruckners in operation
Windbox pressure	0 to -5 psi	1.9 to 2.1	2.0 to 2.5
Bed pressure	0 to -100 inches of water	7.5 to 11.0	18 to 25
Freeboard pressure	-5 to -15 inches of water	6.0 to 11.0	2.0 to 2.5
Cyclone pressure	-10 to -10 inches of water	0 to 8	0.0 to 0.5
Bed temperature	degrees F.	1,500 to 1,600	
Windbox temperature	degrees F.	135 to 150	
Ratio tons water to tons dry pyrite		0.32 to 0.70	
Exit pressure	0 to 8 psi	3.0 to 5.0	
Oil pressure	0 to 30	7.0 to 9.0	
Oil temperature	degrees F.	120 to 150	
Motor amps		180 to 250	
Pyrite feed rate, dry tons per hour (mill or pond feed)		3.0 to 4.0	
Percent solids		65 to 75	

correlated with the pulp density, is used as the value of the feed rate based on a dry specific gravity for the pyrite of 4.3. The operating range for the feed pulp density is between 65 and 75 percent solids. Normal mill feed runs approximately 20 percent solids.

The gas stream analysis is performed at present by sampling a portion of the junction box gases and by using an Orsat apparatus. The sulphur dioxide content of the gases varies from 10 to approximately 12 percent while the oxygen content is held between 1.5 and 2.5 percent. If no excess air is used in the reactor, a partial roast would result and the reactor products would contain quantities of elemental sulphur and magnetite.

A sample of the daily log sheet

which is filled in by the reactor operators is shown. This log sheet requires hourly rotations and provision is made for summaries of each eight hour shift. The operators are provided with several charts and tables to convert original data to the required values or units which are entered on the sheet. The notations appearing on this illustration of the log sheet show the range of the various instruments and the units of measurement and also show the normal operating range for satisfactory reactor operation. The values entered in the item Number 6 column are of interest to the supervisors as the ratio of total water, i.e. that amount contained in the slurry and that required as cooling water, is roughly indicative of the quality of pyrite being used.

Sulphatizing Copper Sulphides

By EDWARD S. HOWELL
Bagdad Copper Corporation
Bagdad, Arizona

Sulphate roasting of Bagdad Copper Corporation concentrates may be traced as far back as 1927. The early attempts to produce a high copper, low iron, soluble calcine met with little success due to the lack of a roaster of suitable design.

Advent of the FluoSolids Reactor coupled with advances in temperature control equipment placed Bagdad in a position to renew its attempts to convert mill-concentrate-copper to cathode-copper.

Preliminary roasting tests were made by the Dorr-Oliver Company in its Westport, Connecticut laboratory. Following these successful tests, a pilot plant scale was decided upon. Construction started in 1955; the plant

was ready for operation by March, 1956 at the mine at Bagdad, Arizona. The plant was designed to treat five tons of concentrate per day, containing approximately 26 percent copper, 26 percent iron and 31 percent sulfur.

Initial operation was attempted while feeding moist concentrate filter cake and operating under a negative pressure. Considerable operational difficulty was due to exhaust fan failure. This fan was subjected to the corrosive gases because it produced the negative pressure. Following the loss of three fan propellers, the decision was made to operate under positive pressure while feeding concentrate slurry.

Difficulty in maintaining fluidity within the bed became a major problem. A space rate of 0.75 feet per second had been considered sufficient to fluidize Bagdad concentrate and tests up to this time strongly indicated

the need for increased space rate.

A direct increase of the space rate would result in an equal increase in the roasting capacity of the reactor. The leaching and electrolytic circuits were designed to accommodate a five ton per day reactor feed. For this reason, it was necessary to decrease the bed cross sectional area by 50 percent in order to double the space rate while maintaining the same fluidizing air volume. The increase to 1.50 feet per second space rate resulted in an increase of solids carryover to the cyclone and scrubber circuit but it also eliminated progressive loss of fluidity within the reactor bed during the roasting period. Solids recovered by the cyclone were approximately 24 percent of the reactor feed.

Roasting originally had been subjected to numerous interruptions and failures. Increase in the space rate, plus a suitable feeding method, placed the operation on a continuous basis and permitted a test program to begin.

Flotation concentrates were delivered to the plant approximately once a week. Although laboratory tests had been made on 26 percent Cu grade, the roasting program was subjected to wide variations in concentrate composition. Rarely did two consecutive deliveries of concentrates contain the same component percentages. Concentrates varying from a low of 15.93 to a high of 38.63 percent copper were satisfactorily roasted by changing fluidizing air volume and feed rates.

Percentage of water soluble copper in the calcine was affected to a larger extent by the copper-sulphur ratio of the concentrate feed than was the sulphuric acid soluble copper percentage. Concentrates containing progressively less sulphur than copper would produce a calcine containing progressively less water soluble copper while maintaining a plus 95 percent sulphuric acid soluble copper. Calcines produced from high sulphur and lower copper concentrates would normally yield a water soluble copper content of 90 to 95 percent and a sulphuric acid soluble content of 97 to 98 percent.

Roasting temperature was the controlling factor governing copper and iron solubilities. Temperatures of 1,300° F. (704° C.) and higher, while decreasing iron solubilities would greatly lower water soluble copper.

Roasting temperatures from 1,270 to 1,280° F. (688 to 693° C.) were considered the most favorable for the production of a high water, sulphuric acid soluble copper calcine while also holding iron solubility to a minimum. Sulphuric acid requirements, with which to conduct a heap leach program, are dependent upon the maximum poundage of tankhouse discard acid possible. Any increase in calcine acid consumption would be at the expense of potential heap leach acid and, for this reason, a high water soluble copper calcine is desired.

Subjection of the copper sulphide to copper sulphating roast introduces bed conditions which are very different from the oxidation roast of chalcopirite or pyrite.

The relatively large percentage of copper sulphate within the fluid bed demands sufficient space rate if satisfactory fluidity within the bed is to be maintained. As previously mentioned, insufficient space rate can result in complete loss of bed fluidity.

The Bagdad Pilot Plant operation has well proven that a defluidized bed is a "dangerous" bed. Numerous bed losses were experienced during the operation as a direct result of deliberate

defluidization for one reason or another. Inability to refluidize the dormant bed will require partial or complete removal of the bed material from within the reactor. Complete removal of the defluidized bed must be followed by a preheating and bedding operation before normal reactor operations many continue.

Copper sulphate, with a melting temperature of 392° F., is the predominating cause of this difficulty. This material imparts a "tacky" condition to the calcine particles and lack of sufficient movement permits these particles to become attached, one to another. The bed can be refluidized only if the shocking force of the initial refluidizing air volume is sufficiently strong to break the bond which holds the calcine particles together.

Bed preparation, prior to planned shutdown, proved of considerable value as a means for permitting refluidization of the dormant bed. Addition of ferric oxide tailing material to the fluid bed results in a coating of the tacky calcine particles and was fairly successful in permitting refluidization.

The most successful bed preparation technique involved the oxidation of the surface copper sulphate to copper oxide, thereby destroying the tacky coating which would hold the calcine particles together. This was accomplished during a period of no feed entry, with the bed in a fluid condition and while temperature was maintained by the use of fuel oil injected into the bed through a bed oil gun. The greater the content of copper sulphate within the bed material the longer preparatory period required. A two hour oxidation period was found to be sufficiently long for a 30 percent copper concentrate feed producing a 90 to 94 percent water soluble copper calcine. Approximately one-quarter hour before defluidization, roasting temperature would be increased to 1300° F. Loss of water soluble copper content, as a result of this treatment, was generally compensated for by a gain in the total soluble copper content. Should bed temperatures drop below 1,000° F. during the defluidized period, the bed oil gun should be utilized immediately following refluidization to recover temperature loss and assure ignition of the incoming feed material. Fluid recovery was achieved, as a result of this type of bed preparation, following defluidized periods of 27 hours with concentrate feed copper of 36.25 percent.

Following 16 months of operation the program was terminated. Sufficient metallurgical and operational information had been accumulated upon which a commercial operation could be designed.

FluoSolids

By DONALD MacASKILL
Dorr-Oliver Incorporated
Oakland, California

The term "two-stage roasting" as applied to the fluidizing technique is a generalization intended to cover fluidizing processing where, in most cases, two compartments or two units are used to effect a chemical or physical change. It is felt that this type of installation could be further divided into sub-units of the basic two stages, where this is indicated. Two stage roasting does not encompass multi-compartment units where the auxiliary compartments are utilized for heat exchange or dehydration purposes.

The initial commercial application of this equipment has been in the treatment of gold ores, and has been described in the paper "How FluoSolids Roasting Aids Gold Recovery at Dalny Mine," by Philip Rabone, and in Mr. Mortimer's and Mr. Tait's paper on Giant Yellowknife. The first unit to be placed in operation was installed, also in Yellowknife, for Negus Mines and commenced operation in February, 1952. Since then additional FluoSolids two-stage units have been installed, or converted from single stage units, in Canada and South America.

Basically, the initial stage consists of holding a fluidized bed of material at an optimum temperature and subjecting the solids to controlled gas phase conditions. These gas phase conditions, in sulphide roasting, normally represent operating with a deficiency of oxygen. Careful heat balances are required since the ability to hold temperature is, of course, related directly to the amount of oxidation that takes place. In view of the above, it can be seen that two-stage roasting is basically a partial roast, followed by a completion roast.

Some of the more apparent applications for this type of treatment in addition to gold roasting, are summarized as follows:

►► Two stage roasting of pyrites and pyrrhotites for the elimination of volatiles, sulphur, and base metals, that would be detrimental in subsequent steel making processes.

►► Two stage roasting of copper concentrates for elimination of volatiles. Partial roasting of copper may be included here, where the product from the reactor goes to smelting equipment.

►► In a more speculative sense, two stage roasting of zinc concentrates offers some promise through a low temperature roast to minimize

Processing for Selective Roasting

ferrite formation, followed by a completion roast. Conversely, a high temperature initial stage will promote lead removal.

►► Other variations are possible where the first stage is held at temperature and the solids reacted with special gases, and the treated solids are then given a finishing treatment in the second stage.

Pyrite and Pyrrhotite

In many countries roasting plant calcine is used as feed to steel mills, and to a lesser degree in this country. Frequently the calcines contain copper, lead, zinc, and arsenic, which are held to be highly obnoxious by ferrous metallurgists. A FluoSolid sulphating roast has been used in Japan to solubilize the copper and to a lesser extent the zinc constituents. A two-stage roast may well fit this problem; the primary stage removing arsenic and some lead, and the secondary stage solubilizing the copper and zinc. A plant is now being built for arsenic removal. Because of the temperature control with FluoSolids units, and the temperature limits imposed by the fusion points encountered in pyrite roasting, it does not appear practical at this time to remove zinc by volatilization.

A convenient method of evaluating the probability of success using FluoSolids is to relate the CaO and MgO in the pyrite to the arsenic present. A low CaO and MgO would consist of some 0.8 mols of these constituents per atom of arsenic. A high ratio would be in the order 2.5. These basic oxides tie up arsenic in a non-volatile form and consequently interfere with the object of the treatment. There is, however, a saving factor in that the subsequent compounds are soluble in dilute sulphuric acid, and retain this solubility even when they are treated to a high temperature desulphurizing second stage.

A further general way of classifying this treatment is to relate to the pyrrhotite and magnetite in the first stage product (when roasting pyrite). Since this paper covers two stage roasting, only in a summarized form, unusual characteristics and inevitable exceptions to every rule will be overlooked in an attempt to reach a practical conclusion. One of these generalizations is that when roasting pyrite to pyrrhotite a temperature range of 1200° F. will produce excellent arsenic removal. It is of interest that fluidizing entrance gases containing only nitrogen and sulphur dioxide will apparently not produce as good arsenic

removal. When utilizing air for fluidization, as the partial roasting conditions are moving away from making just pyrrhotite to a situation where a pyrrhotite-magnetite mix is produced, the degree of arsenic elimination will suffer.

In partial roasting where considerable amounts of iron oxides are produced, very good arsenic elimination is obtained, although the amount driven off is somewhat less complete than from a roast producing pyrrhotite. It is noteworthy that the indications are that as long as the roast contains substantial amounts of iron oxides, it seems to matter relatively little to what exact extent the pyrrhotite first formed has been further oxidized to magnetite. The apparent dependence of successful arsenic elimination on high temperature is a matter that can be taken advantage of in pyrite roasting; whereas, in arsenopyrite roasting factors relating to the subsequent cyanidation process prohibit high first stage temperatures. Furthermore, the British Thermal Unit (BTU) value of arsenopyrite is approximately 1,950 BTU per pound; whereas, pyrite will run in the order of 2,990 BTU per pound. In cases where the fuel content of the feed falls short of the requirements to obtain optimum metallurgical performance, it is considered feasible to introduce auxiliary fuel. This has not been resorted to, as far as is known, in two stage work, but has been used in single compartment FluoSolids units with effectiveness and ease of control.

In the second stage of such a process, where it is desired to sulphate copper and zinc, an atmosphere that is highly oxidizing has yielded results in laboratory work that are encouraging. In view of the very low maximums established by the steel industry for the various contaminants, the success of this type of treatment is dependent to a large degree on the original amounts of the undesired elements. Steel company requirements vary to some degree, but in general maximums of 0.05 to 0.1% As, 0.15% Pb and 0.20% Zn, and 0.20% Cu, are encountered. With the increasing use of sintering plants by the steel producers, a certain amount of tolerance may be expected in the future where zinc is concerned, since this will be driven off, very substantially, in the sintering process. The Dow Mining Company in Japan is obtaining sufficient solubilizing of copper and zinc to produce a satisfactory blast furnace

feed. The FluoSolids installation for Bethlehem Steel at Sparrows' Point, described by Scharf and Dominguez, is sulfate roasting a cobalt bearing pyrite derived from their Lebanon Mine. The ratio of iron to cobalt in the feed is 20 to 30:1. The ratio of cobalt to iron in the leaching solution is 3.5:1, which indicates the effectiveness of the differential sulphating obtained. Cobalt extraction averages 90%, iron reporting in solution is about 0.75%. The sulfur dioxide content of the gases is 7 to 8 per cent, with an oxygen content of 6 to 7 per cent, and sulfur reporting as sulphur dioxide is 80 to 83 per cent of the sulphide sulfur. Over-all conversion of sulphur to sulphuric acid is 75 to 78 per cent of the sulphide sulphur.

Copper Concentrates

A conventional FluoSolids two stage roast shows promise for arsenic bearing copper concentrates.

Considering the first stage only, this product could go directly to reverberatory furnaces. Magnetite formation in the calcine may possibly be avoided through the use of a secondary stage. Looking ahead further, the trend is towards elimination of the reverberatory, and the product control inherent in fluid bed units is of value. A further tangible advantage is that very large tonnages may be roasted in a single fluidizing unit. This is particularly so under partial roasting conditions. Between 500 and 1,000 tons per day can be treated in a single unit, normally without fuel. The controlling factor is the percentage of sulphur removal. Fluxes may also be heated and dried in the same unit.

At the present time, a two stage FluoSolids pyrite roasting plant is under construction in Spain, consisting of two 14 foot internal diameter, two compartment, reactors for burning 90 tons per day each of pyrite containing approximately 0.4 percent As and certain amounts of copper and zinc. An acid plant will be used in conjunction, and the leached calcines will be suitable for steel production. The specifications call for a residual arsenic of 0.1 or less. Base metals will be solubilized to the extent of 65 to 75 percent. Following cyclone collection of the dust, waste heat boilers will be installed for heat recovery purposes, and steam recovery of 1 to 1½ pounds per pound of pyrite is expected. The pyrite fed to the units is to be 100 percent minus-¼-inch.

Partial roasting, or other special initial treatment, followed by a finishing roast or procedure, offers much promise for the future. Fluid beds have several very definite advantages, which basically may be reduced to: 1. Control, and 2. Capacity.

PRODUCTION EQUIPMENT PREVIEW

PEP is just what new equipment, increased mechanization, and new methods can give to your mine, mill or smelter. This PEP section is MINING WORLD's way of making available to you some of the finest current information on mechanization.



New Rotary Bit Used In Percussion Drilling

The Type WBS, a new rock bit, is announced by Oil Tool Manufacturing Co., Inc., Tonkawa, Oklahoma. The rows of teeth are so arranged as to cover the entire hole bottom being drilled. The WBS is designed to drill extremely hard formations such as chert, quartzite, and granite. Cones are offset 2° from apex to create a chipping action on the hole bottom at all times. Downward pressures of 4,000 to 6,000 psi of bit diameter can be applied with safety at rotary speeds of 35 rpm or less. Heat treating in controlled-atmospheric furnaces reduces distortion and insures long wear. A feature of the new drill bit design is its use in percussion down-the-hole hammer drilling. Bearings in the bit are fit to withstand shock without breakage. The WBS bit is available in sizes 5 3/8 inches, 6 inches, 6 1/4 inches, 6 3/4 inches and 7 3/8 inches. For additional information write company at address given above.



Ortrac Has New Utility Truck For Underground

Here's an all new utility underground vehicle being produced by Ortrac, Inc., 320 South Grand Ave., St. Louis, Missouri. This type vehicle is used for transporting supplies, men and equipment underground. It has a 7-foot by 9-foot bed and is equipped with a GM Diesel engine with exhaust scrubber. Features include rugged construction for uneven mine floors, overload springs, low head room and four-wheel drive for maximum traction. Write company for more details.

New Hydraulic Jumbo Arm Announced By Le Roi

A new hydraulic jumbo arm which provides greater flexibility of drilling, more rapid positioning, and more accurate hole spacing is now on the market. The new LJB jumbo arm is available in three lengths, with 4-ft. telescopic extensions offered on two of the three lengths. It is marketed by the Le Roi Division, West-



inghouse Air Brake Co., Milwaukee 1, Wisconsin.

Designed for use in mining, quarrying, and construction tunneling or trenching, the LJB jumbo arm can be mounted on drill jumbos, crawler tractors, or truck platforms. Controls can be mounted on either side of the arm or on the pedestal. A two-gallon capacity line oiler can be furnished as accessory equipment. For more information, write company direct.



Reduced Size 1,075 CFM Compressor By Copco

Introduction of a compactly designed and economically-operated air compressor delivering 1,075 cubic feet of air per minute at 100 PSI has been announced by Atlas Copco.

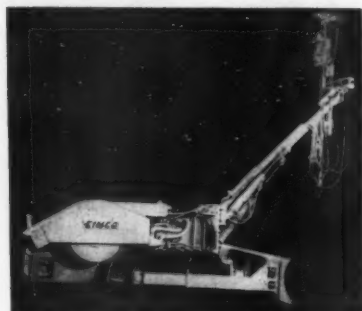
Weighing only 6,600 pounds, the new "ER-6" may be installed either as a stationary unit or mounted on a skid-frame as a semi-portable machine for construction, mine development or other temporary use. Atlas Copco spokesmen said the ER-6 needs less than two-thirds the amount of floor space required by other



Vickers' Tractors Roll Off Assembly Line

The British Ministry of Supply recently placed an order for tracked earthmoving equipment with Vickers-Armstrongs (Tractors) Limited, London, England. This order is one of the biggest placed for this type of equipment since World War II, and includes 60 Vickers Vigor tractors and associated equipment to a value approaching 750,000 pounds. The Vickers tractor is powered by a Rolls-Royce Diesel engine. The photograph above shows one of the first units coming off the assembly line. The men in this special MINING WORLD-WORLD MINING picture, taken at Vickers' Newcastle Works, are: left, G. J. Onions, managing director of Onions Ltd.; center, J. Hendin, director and general manager of the Vickers Tractor plant at Newcastle; and, right, A. P. Wickens, managing director of Vickers Armstrongs (Tractors) Ltd.

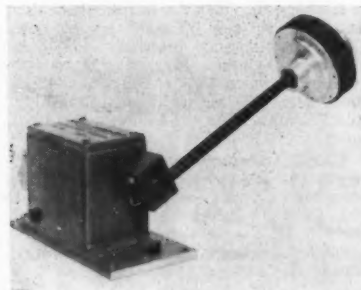
machines delivering comparable amounts of free air. A special Atlas Copco base frame, designed to be cast directly into a permanent concrete foundation, simplifies erection and alignment of the unit as a stationary machine. A newly-designed intercooler incorporated in the ER-6 draws only 560 gallons of 60 F. cooling water per hour—less than half the amount usually required by compressors with comparable air output. The ER-6 is available for coupling to a synchronous motor or direct coupling to standard induction motors. Machines also may be factory-equipped with either flange-mounted electric motors or with flywheels for flat or V-belt drive.



Eimco Develops New Dozer and Mine Roof Bolter

The Eimco Corporation, Salt Lake City, Utah has announced development and production of a new Electric Dozer and Mine Roof Bolter, designated Eimco Model 637. Shown with the hydraulically operated roof bolter attachment, the dozer unit operates on AC or DC motors, which drive the pumps providing hydraulic power to independently activated tracks and to the dozer, drill boom and cable reel. Traction control valve affords three speeds forward and three reverse. Motors and switch gears are approved for gassy coal mine use. The boom permits fifty degree lateral movements and folds back when not in use, permitting dozing in less than five feet of headroom. Dual-purpose dozer blade acts as stabilizer.

For further information, write The Eimco Corporation, P. O. Box 300, Salt Lake City 10, Utah, U.S.A.



Conveyor Belt Control Senses Load and Motion

A new type load and motion sensor to start, stop or control sequencing of automatic conveyorized operations has been developed by The Johnson-March Corp., Philadelphia, Pa. The new unit, called Sentron, will signal any combination of

conditions involving load or no-load, motion or no-motion of a conveyor belt.

The Sentron can be used in many ways in mining and related fields to stop other belts or equipment in case a conveyor slips or breaks; to control the sequence operation of a conveyor system; as a remote control signal to an operator that conveyors are running empty or loaded; to indicate conveyor slippage or not running empty or loaded; and as a means of actuating other equipment based on a set of go-no-go conditions. For additional information write firm at 1724 Chestnut St., Philadelphia 3, Pennsylvania.

New Symons Cone Crusher Bulletin By Nordberg

A newly revised bulletin describing Symons Intermediate Cone Crushers has been released by Nordberg Manufacturing Co., Milwaukee, Wisconsin. Rugged yet relatively lightweight, these crushers are built in 22" and 30" sizes with fine or coarse type crushing cavities for second and third stage reduction crushing.

A schematic cross section of a 30" Symons Cone Crusher identifies the principal features of the Intermediate Cone Crushers. The advantages of controlled feed and even distribution are featured along with a table giving average capacities at various settings and feed openings. The Symons principle of reduction crushing is explained and the crusher's lubrication system and automatic protection against damage from non-crushable material is described.

The revised eight page, two color bulletin also features low cost per ton of crushed products with Symons intermediate Cone Crushers and their adaptability for use in mobile crushing plants. The bulletin, No. 236A, is free.



Conveyor Protection By Ralph C. Gardner & Co.

Conveyor failures can now be instantly detected, according to the Gardner Co., 14112 Lima Road, Fort Wayne 8, Indiana. Shut-off, or signal, or both may be accomplished by means of a new Over Under Controller. Actuated by means of any change in current demand, either up or down, the desired protection is possible. Pickup is made by means of a current transformer. There is no need to cut into or to disturb any existing wiring. Installation is possible at either point of operation or at a remote location. Control is 100% automatic, and there are no moving parts, tubes, maintenance or manual operation. For additional information write to company at above address.

Notes From The Manufacturers

HENRY B. WOODS has recently been appointed director of research at Hughes Tool Company. Mr. Woods has been acting director of research since the retirement of FLOYD L. SCOTT last August. He holds 15 patents, issued in connection with the development of rock bits and tool joints, and is author and co-author of many technical papers on this subject.



Bucyrus-Erie Company's Drill Division has sold its first Winkie drill. Destined for exploratory drilling in Greece, the Winkie was shipped to AMROCTA Co., New York City, New York, from Bucyrus-Erie's Drill Division plant at Richmond, Indiana. Bucyrus-Erie recently acquired the Winkie, a portable, lightweight, diamond core drill for exploration and test hole work, from the Wink Corporation, Brookfield, Wisconsin. Production, sales and shipment of the Winkie have been assigned to the Drill Division at Richmond. The Winkie, which supplements Bucyrus-Erie's line of water well, oil well and blast hole drills, will be sold throughout the world.

JOHN R. BURKETT has been appointed general sales manager for American Cyanamid Company's explosives and mining chemicals department. Mr. Burkett will direct commercial operations of the department's newly formed regional sales organization from his headquarters in New York. Mr. Burkett joined Cyanamid in 1935 as a trainee at the company's Bound Brook plant and most recently served as assistant to the manager of the explosives and mining chemicals department. E. C. FARRAR has been named eastern regional manager and O. R. BROWN, western regional manager.



Elwynne J. Smith has been appointed advertising manager for The Eimco Corporation's Filter-Process Division, Salt Lake City, Utah. Mr. Smith comes to The Eimco Corporation from Allis-Chalmers Manufacturing Company where he was promotion supervisor for that company's Industrial Equipment Division.

John W. Jamar has been promoted to sales engineer for the mining machinery division of Lake Shore, Inc. He will work under James W. Clark, manager of the mining machinery division in Iron Mountain, Michigan. Mr. Jamar has served as sales engineer for Lake Shore's Service and Supply Division since 1956. The mining machinery divisions includes mine cars, skips, cages, sheaves, hoists and other special machinery.

Personalities in the News

JOHN R. RAND, state geologist of Maine since early in 1956, has resigned this position effective June 30th, and will return to private practice as a geologic consultant in Augusta, Maine. Mr. Rand also serves as a director of the Copper Range Company, White Pine Copper Company, and the Big Sandy Company. As state geologist, Mr. Rand devoted his attention to establishing the State Geological Survey as a centralized information agency on Maine geology, and re-writing state mining laws for practicable operation.



Henry P. Day has been elected president of the Valley Dolomite Corporation, St. Louis, Missouri. He succeeds Charles M. Day who was appointed Chairman of the Board. Ben P. Donnell, former general manager and vice president in charge of Valley Dolomite operations, was named vice president.

Harry A. Shaw, former superintendent of Kennecott's Garfield, Utah copper refinery, was named assistant to the general manager of White Pine Copper Company in Michigan. Mr. Shaw, a graduate of the University of Washington, was associated with American Smelting and Refining Company before joining Kennecott Copper Corporation in 1940 as assistant smelter superintendent at Braden Copper Company, Chile.

E. M. Furness, superintendent of Reserve Mining Company's crushing and concentrating department, has been advanced to the position of assistant executive vice president. Before joining Reserve Mining Company in 1952, he was associated with Republic Steel Corporation as an engineer and as concentrating superintendent at its Lyon Mt., New York operations.

Robert C. Hills has been elected president of the Freeport Nickel Company, a subsidiary of Freeport Sulphur Company. Mr. Hill, a graduate of Tulane and Cornell Universities, joined Freeport Sulphur in 1934 as assistant chemist. He will continue to serve Freeport Sulphur Company as executive vice president and director.

Five promotions at the Brewster, Florida plant of American Cyanamid Company have been announced. M. W. Chesson, former triple superphosphate manager, has been named assistant to the manager of phosphate operations. F. Alan O'Neill, who has been Mr. Chesson's assistant, has been named to succeed him as manager. Robert N. Saunders has been promoted to assistant development superintendent; S. Clyde Watkins to assistant to the mines manager; and U. K. Custed to mining shift supervisor.

Robert R. Portmess, staff industrial engineer for Kennecott's Western Mining Division in Salt Lake City Utah has been named industrial engineer at the Garfield smelter of the Utah Copper Division of Kennecott.

Following a decentralization move by the company, E. L. Joppa, Duluth, general manager, announced personnel changes by the Lake Superior Mining Division of Pickands Mather & Co. T. C. Thielman, general superintendent of the Hibbing District, will be transferred to Duluth where he will serve as assistant to the general manager, Open Pit Operations. Bruce Stunkard, Hoyt Lakes, general pit foreman for Erie Mining Company, will move to Duluth as administrative assistant to Mr. Thielman. F. R. Werther, Ironwood, assistant general superintendent of Gogebic District, will also be transferred to Duluth to fill the new position of assistant to the general manager, Underground Operations. W. E. Seppanen, Caspian, Michigan, superintendent of the Iron River District, will be transferred to Duluth where he will serve as administrative assistant to Mr. Werther. C. D. Bailey, Ironwood, general superintendent of Gogebic District, will take charge of PM properties on the Menominee and Marquette Ranges. Other personnel changes include: L. M. Becker, operating assistant in Duluth, to superintendent, Danube Mine at Bovey; A. M. Anderson, superintendent of Tioga No. 2, to assistant superintendent at Danube Mine; and W. L. Thomte, superintendent of the Danube Mine, to Embarrass Mine at Biwabi, where he will become superintendent succeeding G. C. Watts, who is retiring. R. T. Bell, assistant general superintendent of the Hibbing District, will become superintendent of Tioga No. 2 and West Hill Mines. J. E. Schelske, assistant superintendent at the Scranton Mine, will become assistant superintendent under Mr. Bell. T. R. Tregembo, superintendent of the Albany Mine, will be transferred to Scranton Mine as superintendent. Cecil Scott, general plant foreman at the Mahoning Mine, will be transferred to Bennett mine where he will serve as operating assistant to E. R. Tyler, superintendent. A. L. Johnson, operating assistant in Duluth, will become superintendent of Mauthe Mine at Ironwood. John H. Sharrer, chief engineer for Gogebic District, will become an assistant superintendent at the Mauthe Mine, joining A. J. Cigallio, now an assistant superintendent there. Russell L. Jose, superintendent at Mauthe Mine, will become superintendent.

W. S. HUTCHINSON, JR., has been named director of the Source Material Procurement Division of the Grand Junction Operations Office, United States Atomic Energy Commission. Mr. Hutchinson, who joined the Grand Junction office in 1949, has served as assistant to the manager since 1955. Mr. Hutchinson, a graduate of Massachusetts Institute of Technology, has served the domestic mining industry in the United States and Mexico.



RAY SCHULTZE, manager at Rio De Oro Uranium Mines, Inc., Grants, New Mexico, has been elected vice president and general manager of operations of Rio mining operations. Mr. Schultze, a graduate of the University of Idaho, joined Rio De Oro in March 1957



as manager of the Dysart No. 1 Mine in Ambrosia Lake, New Mexico. During the early phases of the "uranium boom," Mr. Schultze was employed by the Hidden Splendor Mining Company at the Delta mine as superintendent, and later at Moab, Utah, as assistant general superintendent of mining activities in that area for Hidden Splendor.

dent of the Cary Mine. John C. Wangaard, will continue as superintendent of Peterson Mine at Bessemer. At the Hoyt Lakes plant of Erie Mining Company, B. F. Borgel has been named assistant works manager, operations, and J. H. Healy has been appointed assistant works manager, service.

Roger Pierce, consulting engineer, of Salt Lake City, Utah, was in Cuba and Honduras in January on consulting work.

J. Carlton Ward, Jr., president of the Vitro Corporation of America, has been elected chairman of the board of Heavy Minerals Company, Chattanooga, Tennessee. In other changes, William H. Denne, Jr. and William B. Hall have been elected to the Heavy Minerals Company board.

Ernest Gordon, formerly with Mineraçao Hanna Company, at Belo Horizonte, Brazil, has moved to El Paso, Texas.

L. P. Peterson, vice president and general manager of Bethlehem Iron Mines in Chile, has returned to his headquarters in Chile. He was in the United States to confer with Bethlehem officials concerning expansion of Bethlehem operations in Chile.

Richard E. Mieritz mining consultant with former offices in New York City, has recently opened an office in Phoenix, Arizona. Mr. Mieritz is currently working on a copper assignment and will make his headquarters in Phoenix for the next several months.

E. C. Anderson, consulting mining engineer and geologist of Socorro, New Mexico, has opened new offices at 130 Center Street in Socorro. Carl Dotson of the Dotson Minerals Corporation is associated with Mr. Anderson at the new location.

Stanley F. Johnsen has been appointed shovel foreman at Kennecott Copper Corporation's Ray Mines Division in Arizona. Mr. Johnson was formerly associated with Lone Star Steel Company and the Hecla Mining Company.

George R. Remarcke has been named underground foreman at the Hiawatha mine, M. A. Hanna Company, Michigan mining district.



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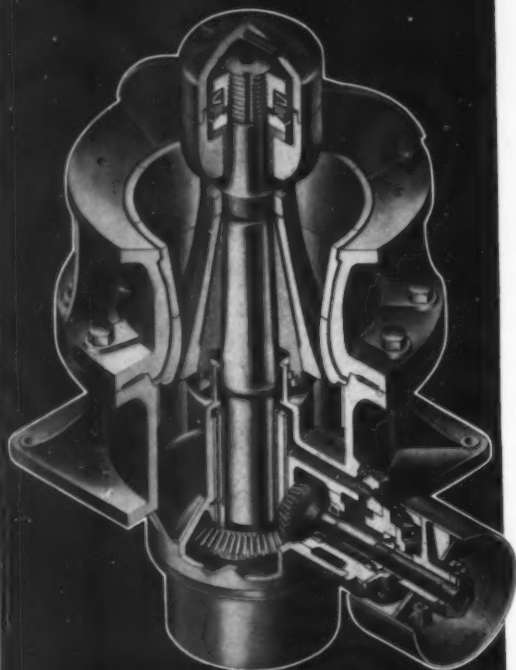
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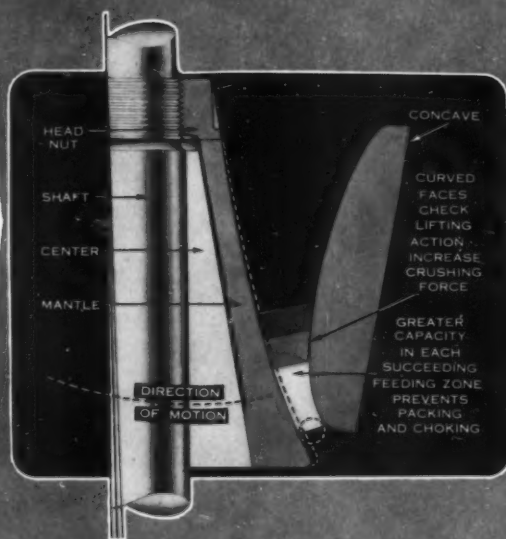
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Wide Exploration Interest at AIME

The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) held its annual convention in the mining west in San Francisco, California in mid-February.

It turned out to be an exploration convention, a geologists'-geophysicists' convention, for they dominated attendance, drew the greatest crowd to meetings and lectures, attracted many distinguished foreign geologists, and rightfully and proudly boasted of their accomplishments and ore findings.

New tools and price incentives have made the last few years an exploration era. Witness today's vast reserves of uranium ore, the not too old major nickel discoveries in Canada which have helped end the nickel shortage, the billions of tons of low-grade iron in Canada, the added reserves of zinc in Tennessee, an entire new Lead Belt in Missouri, the talk of porphyry type copper deposits in Arizona, British Columbia's famed Highland Valley, and Quebec's ever-growing Mattagami base metal province.

For proof, the several speakers discussing the 1952 Paley Report all failed to report a serious shortage of any metals; in fact, interestingly enough, but not surprising to the mining industry, was the comment, "Domestic production of all mineral raw materials appears to have been increasing at the same rate as consumption." One observer's comments were well taken when he said that, "This is the geologist's era. We must not go too far in thinking that this time of plenty will continue. Today's successes don't mean that tomorrow's mines can be found by simply giving these men orders."

For exploration, the greatest interest centered on geophysics; quite naturally Canadian speakers outlined the Induced Polarization method and presented profiles to indicate success in locating porphyry type copper in Arizona, a southwest Missouri lead deposit, and a vertical sulphide ore body.

Advantages of the Canadian Aero-Newmont Helicopter Electromagnetic system were outlined by Roger H. Pemberton. This unit has been used with success for massive sulphide ore bodies in the United States and Canada. Mr. Pemberton said, "In no case has the system failed to detect a known massive sulphide occurrence, some of which have been missed in previous surveys with other systems."



John B. Knaebel, MINING WORLD's "Man of American Mining in 1956," receives a second high award for his accomplishments in mining. Mr. Knaebel (left) receives the William Lawrence Saunders Gold Medal from Augustus B. Kinzel, at the annual banquet of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

A new airborne Audio Frequency Electro Magnetic surveying technique, shortened to AFMAG, was outlined by Stanley H. Ward, Toronto, Canada. Increased depth sensitivity and use at relatively high flight levels appear to be the best features of the method.

Underground mining highlight of the meeting was an illustrated discussion of Ambrosia Lake, New Mexico mining by Donald T. Delicate, superintendent, Homestake-Sapin Partners. He reported that water and ground conditions pointed to the need for new equipment and that the mining companies were cooperating with manufacturers in developing and perfecting such equipment.

Open-pit mining sessions dealt with use of ammonium nitrate for blasting and selection of haulage units. John R. Knudson, Cleveland-Cliffs Iron Company, reported that ammonium nitrate was saving thousands of dollars in Mesabi Range blasting. He foresaw even greater use when a new additive was found or developed which would be more sensitive and water resistant than the Diesel oil now used.

C. S. Davis, general vice president, Utah Construction Company, reported that the way to figure improvement in equipment and operating procedure

was by comparing wage and labor costs. At one mine, from 1952 to 1957, labor rates increased 29 percent, but the labor cost increased only 10.5 percent, despite hauling three times as far.

It costs eight percent less to move muck by Diesel electric trains with 30- or 40-cubic-yard cars than it does by efficient trucks, reported W. N. Matheson, Oliver Iron Mining Division of United States Steel Corporation. Rail advantage is more apparent because muck is elevated an average of 271 feet by rail and only 144 by truck; distances are 4.3 miles by rail and only 0.78 for truck.

Normal Weiss, milling engineer, American Smelting and Refining Company, called for a division between engineering and science in the curricula for Minerals Beneficiation at the college level. He recommended separate Metallurgical Science and Metallurgical Engineering curricula.

The highlight of the meeting was the presentation of awards. John B. Knaebel, recipient of the Saunders Gold Medal, said in receiving this award, "I wish it were possible for me to name the 30 people that have worked with me for 30 years. It was their teamwork that made this award possible. I want to thank each of them."

Rio De Oro Sinking Shaft On Parador Mining Lease

Rio De Oro Mining Company has started shaft sinking operations on the Elizabeth Adoor Claim No. 1 in the Ambrosia Lake District of New Mexico. The property, leased from Parador Mining Company, is located in Section 26, Township 13 North, Range 9 West, McKinley County. It is east of the Phillips Petroleum Company's mine and will probably be in a wet horizon. Boyles Bros. of Salt Lake City will sink the shaft to a depth of 1,150 feet. This will make the mine one of the deepest in the Ambrosia Lake district, but it will develop 500,000 tons of 0.33 percent uranium oxide ore. The shaft is expected to be bottomed in April of 1960 and production of 10,000 tons per month is expected by the end of 1960.

To block out the main ore body, more than 100 plug and drill holes were set to depths ranging from 950 to 1,600 feet. This blocking-out operation required three drill rigs and spanned a one year period. Parador will receive a 10 percent royalty on all uranium shipments, plus a \$1.00 per ton bonus on the first 300,000 tons of ore hoisted to the surface.



The Bagdad Copper Company, Bagdad, Arizona, is installing additional crushing capacity consisting of another

secondary and tertiary crusher. The new unit is fed by belt conveyor directly from the primary crusher in the pit, and operates separately from the present reduction crushers delivering its product (¾-inch) to the fine-ore bins at the mill. The installation is designed to relieve the overloaded crusher circuit and thus assure a maximum feed rate to the ball mills, and possibly augment plant capacity. Production for 1958 was approximately 24,000,000 pounds of copper produced from ore carrying just under 1.00 percent copper. Milling rate is 4,700 tons per day. George Colville is general manager, employing an operating crew of 325 men.

Cyprus Mines Corporation has resumed production at its Old Dick mine at Bagdad, Arizona. Low metal prices had caused the company to suspend milling operations in January 1958, after running the new 200-ton mill only eight months. During the shutdown, however, a greater extent of ore of somewhat better grade was developed on the 650-foot level, resulting in the decision to resume production. The mill was rehabilitated and a larger hoist installed to replace the old one. Cyprus proposes to deepen the shaft and open a new level now that the mine is again on production. Curtis Sundeen is resident manager.

Regular production is being maintained by the Commercial mine in the Copper Basin of Yavapai County, Arizona, at the rate of about 1½ cars per day. The copper property is operated under lease by Fred D. Schemmer, of Prescott, Arizona. He employs a regular crew of six to eight men six days a week.

Mining of manganese ore was started in January at the Black Diamond mine 18 miles north of Patagonia, Arizona. The

property is owned by the Boulder Mining Company, of Patagonia. Principals in the company are Harry Zabel, LeRoy Knott, and James Williams. So far, three men are employed, working with pick and shovel in a small open cut, handsorting the ore and dumping into a stockpile. The sorted ore is expected to run better than 50 percent manganese.

Magma Copper Company, Superior, Arizona, returned to a six-day work-week effective March 1. The company had adopted a five-day week in January 1958 when low copper prices and high surplus stocks made a cut in production advisable. According to Darrell Gardner, general manager, the same production schedule has been established as was in effect before last year's cutback.



Jefferson Lake Sulphur Company has been granted the right to explore and develop an asbestos property in Calaveras County, California owned by American Asbestos Mining Corporation. Reports on the property by expert geologists and mining engineers are said to have been favorable and to indicate a deposit of chrysotile asbestos.

Kaiser Aluminum & Chemical Corporation of Oakland, California and Mexico Refractories Company of Mexico, Missouri have been negotiating over possibilities involved in merging their refractories businesses.

Latest drilling information from Molybdenum Corporation of America on its Mountain Pass, California bastnaesite deposit is that about 20,000,000 tons of ore have been developed, averaging around 10 percent rare earth oxides. There are indications, too, that the deposit may be as deep as 2,000 feet.

The large government-owned magnesium plant at Manteca, California may soon be available for private industry. The facilities were built by Kaiser Aluminum & Chemical Corporation during World War II, and have been closed since the end of the Korean War in 1953. About three years ago, the Western Pyromet Corporation negotiated with the government for a lease on the property, and actually did run a few titanium tests, but this venture was dropped after a few months. The General Services Administration has now been notified that the plant has been removed from the restrictions of national security clause, and is available. GSA contacts other government agencies first to determine if there is a need for the plant. If not, the plant will then be offered to the Department of Health, Education and Welfare to see if local agencies could use it. The Manteca Union High School might be interested in part of the site for a new high school. Then the remainder of the property, including the main building, will be offered to private industry without restriction.

The General Electric Atomic Power Equipment Department (APED) recently completed an eight-day experiment in which electricity was directly produced from a radioisotope using a thermionic converter under gamma radiation con-



Development Work Under Way at Goldfield

The picture above shows a part of famous old Goldfield district of Nevada. In the left center is the Laguna shaft; the Florence property and the Newmont Mining Corporation mill are in the middle distance; and the dump at the old Booth shaft is in the left foreground. This picture was taken near the portal of the Prospector's Friend mine on Columbia Mountain, now being operated by Goldfield Engineering Associates of Las Vegas, Nevada. The original adit was driven about 800 feet by George Wingfield during boom days. Several years ago, the adit was extended about 200 feet by Harold V. Lankford, now one of the directors of Goldfield Engineering. Present operations were contracted to Kelly & Clark who are presently cross cutting, starting at a point, 300 feet from the portal. The lateral is being driven westerly to a point below a 400- by 700-foot surface showing so that the ore body may be mined by stoping.

ditions. The experiment was conducted at APED's Vallecitos Atomic Laboratory near San Jose, California, using gold as the radioactive source material. The gold was selected as the radioisotope because it permitted an accelerated feasibility test under a gamma radiation atmosphere.



This past winter Kennecott Copper Corporation's Nevada Mines Division has been using a new method to prevent the ore from freezing to the side of ore cars. An automatic salt spray has been installed which coats the inside of the car with enough salt to prevent freezing. It is mounted on one of the trolley bridges near the railroad cut, south of the crusher. Photoelectric eyes allow the spray to operate only when an ore car is in position under the nozzles. The entire installation was made by the reduction plant maintenance department.

Cold weather and snow have forced temporary suspension of open-pit mining and gravel washing operations by Round Mountain Gold Dredging Corporation at Round Mountain, Nevada. This was the economical thing to do because several inches of snow in the pit and continued freezing of both gravel and washed tailing on the conveyor belts made efficient

operation impossible. Weather conditions will determine reopening date. Production in 1959 has been at a high rate because mining was done in a very high-grade gold zone. J. H. Ashley is general superintendent.

Eljo Oil & Mining Corporation of Las Vegas, Nevada is setting up a pilot plant to test a uranium oxide recovery method developed by Comprehensive Chemical Company under Eljo's direction. According to Joseph J. Peltz, president of Eljo, sodium diuranate, C.P. approximately 85 percent U_3O_8 has been recovered from ore of the lowest grade.

Ohio Mining Company has contracted with Robert Milton and Harold Foss of Bishop, California for operation of the Ohio gold mine at Goldpoint, Nevada. Mining will be continued under their supervision. The firm has had a contract with U.S. Milling and Minerals Corporation to ship to the latter's mill at Silverpeak.



United Perlite Corporation's new mill near Tres Piedras in northern Taos County, New Mexico has gone into operation. It is the fourth perlite mill in the area, and will produce 200 to 250 tons of perlite in an eight-hour shift. It is de-

signed for continuous operation and can go on a three-shift basis when needed. With less than 50 percent of its claims drilled, the new firm says it has sufficient reserves of high-grade perlite to keep the mill in operation for 20 years.

Phillips Petroleum Company has sunk its second mine shaft 1,000 feet and expects to complete mine development late this year. A third mine will be 1,500 feet deep where development is scheduled to be completed early in 1960. These are the Sandstone and Cliffside mine in the Ambrosia Lake district of New Mexico. The first mine, the Ann Lee, is already in operation, along with a 1,725-ton mill.

Kermac Nuclear Fuels Corporation's new 3,630-ton-per-day uranium mill is now running smoothly, although delays in mine construction caused a shortage of ore, curtailing the mill's production in January to 70 percent of capacity. Production is being gradually increased over the next few months as mine development is completed.

A measure designed to ease some of the economic burden faced by New Mexico's potash industry has received a favorable report from a New Mexico House committee which gave the bill a do pass recommendation. The bill introduced by representative Drew Cloud of Eddy County concerns the severance tax on minerals and sets out that the severance value of potash shall be reported at 75 percent of the market price on which the value is based. Cloud estimates the bill will save the slumping New Mexico industry about \$150,000 to \$200,000 a year in severance taxes.

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Aluminum Company of America is stepping up its bauxite mining operations in Arkansas, and may also increase alumina output from its refining plants at Bauxite, Arkansas and Point Comfort, Texas. Improved business conditions are responsible for the expansion.

A fire in the Ozark-Mahoning Mining Company's mill at Rosiclare, Illinois, destroyed the crushing and screening department and closed the mill for at least a month. Firemen were able to prevent the fire from spreading to the flotation section. The fire had started below the crude ore storage tanks which were kept heated to keep the fluorspar ore from freezing. It ignited one of the conveyor belts carrying ore to the crushing department and the moving belt carried the fire up to that department. The firm reports it has enough concentrates in storage to meet shipments until the plant resumes operation.

The annual meetings of the American Zinc Institute and the Lead Industries Association will be held April 22 through 24 in The Drake Hotel, Chicago. The lead group will meet during the first two days, and the zinc group on the last two days; a joint meeting of the two will be held on April 23.

Continued depressed conditions in the lead industry and a steady increase in unsold stocks are cited by St. Joseph Lead Company as the reasons for reducing mining and milling operations in southeastern Missouri by 20 percent. The reduction was effected by cutting the

work week to four days. At the same time, development work was stopped at Mine La Motte. At Herculeanum, the smelter went from a six-day operation to five.

The U.S. Atomic Energy Commission will conduct a small-scale, field study of the possibility of disposing of radioactive wastes in natural salt formations. A contract has been signed with the Carey Salt Company of Hutchinson, Kansas, and the work will be undertaken in an abandoned portion of Carey's Hutchinson mine. The study will involve no radioactivity because simulated wastes, rather than actual radioactive wastes, will be used. The experiments will start this summer, and are scheduled to be completed in January 1960. The Carey mine was selected after an extensive survey of various mines; it was chosen because of the geology of the area, its geographic location, and the facilities available at the mine. Cost of the work is estimated at \$42,000.

Mallinckrodt Chemical Works has formed a separate company, called Mallinckrodt Nuclear Corporation, to handle the nuclear fuels work for the organization. Mallinckrodt Chemical has processed more than 150,000 pounds of enriched uranium at its \$2,000,000 nuclear fuel production center at Hematite, Missouri since 1956. The company takes enriched uranium hexafluoride from the AEC and processes it into forms and compounds suitable for reactor use.



Texas Gulf Sulphur Company has obtained a five-year option on lithium min-

ing properties in North Carolina, owned by Basic Atomics, Inc. The properties are located between Gastonia and Lincolnton. Included in the agreement is a five-year option on patent rights to a new Basic Atomics process for recovery of lithium from spodumene-bearing ores and concentrates.

Vitro Corporation of America has acquired Crane Company's interest in Heavy Minerals Company. This now gives Vitro 87% percent ownership in that firm; a minority interest is held by the French group of Pechiney, known as Societe de Produits Chimiques des Terres Rares.

The General Services Administration has requested bids on production of ferrovanadium from government owned vanadium oxide now held in the government stockpile. When processing is completed, the ferrovanadium is to contain 1,050,000 pounds of vanadium. Bids must be submitted no later than April 15th at 3:00 p.m. E.S.T. For specifications and information, write to George K. Casto, Defense Materials Service, G.S.A., 18th and F Streets, N.W., Washington 25, D.C.

St. Joseph Lead Company's Balmat and Edwards mines in New York State are still operating on a six-day week. Production is primarily zinc with only about 100 tons per month of lead concentrates. The mines produce about 360 tons of zinc concentrates per day.

The Coy mine of American Zinc Company of Tennessee, which was under development all of last year, is now in full operation. The mine is at Jefferson City, Tennessee, and is the fifth new zinc mine to be developed in the Tennessee zinc district since 1950. Some production came from development headings in 1958, but mining by stoping is now in full force.

The Carborundum Company is building a \$750,000 pilot plant for its research and development division in Niagara Falls, New York. The work is expected to take nine to twelve months to complete. New products now produced in a smaller pilot plant—KT silicon carbide, GRB silicon carbide, and boron nitride—will be brought to full commercial status in the pilot plant.

The New Jersey Zinc Company has recently added new equipment to its smelter at Palmerton, Pennsylvania thereby achieving even greater efficiency in the firm's system of producing zinc oxide. Specifically, the method for collection, screening, and packing of the pigment has been redesigned and modernized for less manual handling and more mechanical performance. The only hand labor in the new system is that connected with the machine packing and weighing of the pigment. In addition to improving efficiency in collecting and packing zinc oxide, the changes have resulted in improved storage, shipping, and quality control.

The 1959 Nuclear Congress will be held in the Public Auditorium at Cleveland, Ohio from April 5 through 10. Features of the meeting will be engineering papers dealing with advances in reactor technology and the use of radioactive materials, a trade show, the ATOMFAIR, talks devoted to problems of industrial management in the nuclear field and papers devoted to laboratory problems in radioactive materials. Invitations had been issued to Russian engineers to describe details of their power



New Jersey Zinc's Flat Gap Mine in Production

New Jersey Zinc Company's Flat Gap mine at Treadway, Hawkins County, Tennessee, is reported to have reached a daily production of 1,000 tons. The Flat Gap started producing at the beginning of this year, although development work had been completed in 1958. The company had decided to keep a limited crew on mine development work for about a year until the price of zinc improved. Looking from right to left in the photograph above one can see: the hoist house and sheps, steel headframe over vertical shaft, conveyor gallery, crushed ore bin, and the main mill building which houses grinding, flotation, thickening, and filtering operations. The concentrate is loaded at the far left of the project for trucking to Morristown, Tennessee, site of the nearest railroad. From Morristown, the concentrates are shipped by rail to New Jersey Zinc's smelters.

reactor program, including a 600,000-kilowatt power plant reported to be under construction in Siberia. During the meeting, Sir Claude Gibb, managing director of one of England's leading nuclear development firms, C. A. Parsons, Ltd., will address a luncheon meeting. Other speakers from abroad include specialists from England, France and Italy.

Aluminum Company of America has closed down one of the eight reduction potlines at its Alcoa, Tennessee smelter. The cutback was caused by low rainfall which reduced hydroelectric power in the area.

New York State's first privately owned nuclear reactor has been placed in operation at the Pawling Laboratories of Nuclear Development Corporation of America. The low power reactor, known as the Pawling Research Reactor (PRR), is a prototype of a Teaching and Research Reactor (TRR) which NDA has designed for university use. The new one will be used for research, nuclear studies, and demonstration purposes. It will also provide valuable information in the design and manufacture of more advanced reactors.

Operations have been terminated at the Richard underground iron mine near Dover, New Jersey because of depletion of the ore body. The mine had first been developed in 1854. Most recent operator was the Colorado Fuel & Iron Corporation which acquired it in 1952.

Jones & Laughlin Steel Corporation is building a new ore sintering plant and ore screening facilities at its Aliquippa, Pennsylvania Works. The new unit will more than triple production of blast furnace sinter at the Works, and will improve and increase blast furnace performance by about 20 percent. It will produce 90 railroad cars of high quality blast furnace burden daily. Completion is scheduled for 1960.

Florida's phosphate industry in Polk and Hillsborough counties is estimated to have an investment of almost \$7,000,000 in modern waste control equipment. International Minerals & Chemical Corporation alone spends \$250,000 annually to operate such equipment. Seven major phosphate producers in the area have joined together in an industry research program on air pollution to determine the contributing factors to this problem. Resources Research Inc. of Washington, D.C., has been retained to conduct expert and impartial research.

Lehigh University has received \$10,800 to establish a scholarship endowment fund from Raymond L. McCann, president of New Jersey Zinc Company. The fund is called the R. L. McCann Scholarship, and will be awarded to a student seeking a degree in one of the engineering departments at Lehigh; preference will be given to mining engineering or metallurgical engineering, however.

The American Society of Metals invites participation by the metal industry in a display of native minerals in a "mineral garden" planned for the new ASM headquarters in Cleveland. Any organization interested in participating in the project is asked to contact Dr. C. H. Loring regarding general specifications and nature of the ore in order to avoid duplication of specimens. Headquarters are at 7301 Euclid Avenue in Cleveland. Anaconda Company of Butte, Montana has already shipped a 220-pound specimen of copper ore.



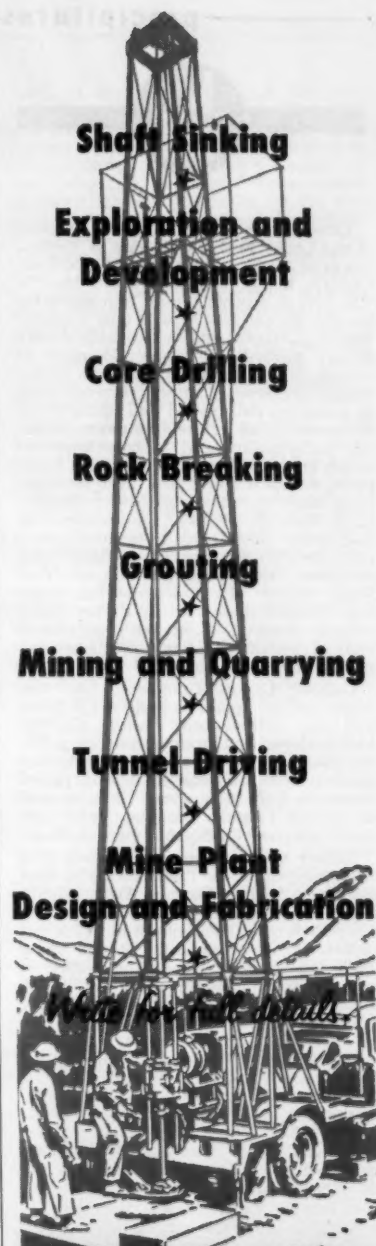
Humboldt Mining Company has retained Arthur G. McKee & Company of Cleveland, Ohio to build its new 2,000-ton-per-day pelletizing unit at Humboldt, Michigan. Western Knapp Engineering Company has been retained to provide additional facilities for a concentrating plant for Humboldt. The expansion will increase the company's capacity to 640,000 tons of pellets annually, about double present capacity. The design of the pelletizing plant will be based on the Allis-Chalmers Manufacturing Company's grate kiln process. Completion is scheduled for mid-1960. Cleveland-Cliffs Iron Company and Ford Motor Company are joint owners of Humboldt.

Under construction this winter has been an extension of the skipway at the Morton mine of The M. A. Hanna Company, located five miles west of Hibbing, Minnesota. Deeper development of the ore body made it necessary to lengthen the skipway to 833 feet and to increase the angle along the pit wall from 25 to 36°. As development continues, plans call for lowering the skipway again; since the mine opened, the track and loading pocket have been lowered three times.

Lake Superior District mining companies are stepping up stripping and construction projects in preparation for 1959 iron ore production. M. A. Hanna Company on the Mesaba Range recently placed its employees on a five-day week instead of the four-day week in effect during the entire winter season. Construction and engineering continues for the W. S. Moore Mariska concentrator at Gilbert, Minnesota. Enlargement of the jig section and the addition of a spiral section will be completed before the 1959 season. Oreclone Concentrating Company at Virginia has scheduled enlargement of its plant at the Prindle mine tailings basin. Jones and Laughlin Steel Corporation is continuing construction and revamping of the Hill-Annex concentrator at Calumet, Minnesota, and engineering continues for 1959 construction of new plant facilities of the Lind-Greenway mine, Grand Rapids, Minnesota. Oliver Iron Mining Division is currently doubling the size of the screening facilities at Stephens mine at Aurora, Minnesota. Also included in this project are changes in the original section to allow loading of coarse and fine crushed ores separately.

Abe W. Mathews Engineering Company, with home offices in Hibbing, Minnesota, has formed an affiliate company, A. W. Mathews of Canada, Limited, with offices in Port Arthur, Ontario, Canada. Present officers of the Hibbing firm hold identical positions in the new company.

Oliver Iron Mining Division of U.S. Steel Corporation has instituted an employee suggestion system for all Oliver personnel. The plan will pay cash awards from \$10 to \$10,000 for acceptable suggestions which contribute to reducing costs, waste, or maintenance; to improving safety or providing better working conditions; to increasing quality or output of products; to conserving materials, power, and time; or to finding ways of adapting present practices and equipment to new purposes.



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IDAHO

Construction of a 400-ton flotation plant at the **Lucky Friday** mine east of Mullan, Coeur d'Alene mining region, Shoshone County, Idaho, will start about May 1. The mill is expected to go into operation around January 1. It will cost approximately \$600,000 and will enable **Lucky Friday Silver-Lead Mines Company** to double its current production rate. Lucky Friday ore now is trucked several miles to a custom mill owned and operated by **Golconda Lead Mines Company**. Multiple underground and surface improvements are planned by **Hecla Mining Company**, which recently took over management and operation of Lucky Friday. L. J. Randall, Wallace, is president of both firms. Hecla recently acquired more than 500,000 Lucky Friday shares and **Newmont Mining Corporation** of New York, largest Hecla stockholder, more than 140,000 shares. Lucky Friday stockholders received \$7.50 per share for a total of \$4,826,430. Some of them paid as little as 10¢ a share.

Copper Camps Company, Inc. has made tentative plans to build a 1,000-ton mill in northeastern Valley County, Idaho, depending upon results of a 25-ton pilot mill moved to the property last season. The firm has lode and placer claims on Big Creek, about 10 miles west of the old Thunder Mountain gold rush area. Company headquarters are in Boise.

Sidney Mining Company, the only firm still operating in the Pine Creek zinc-lead district of Idaho's Coeur d'Alene mining region in Shoshone County, has put the old **Nabob** mine back into production and expects to have monthly output on a 3,000-ton basis by June. The Nabob is adjacent to the **Sidney** mine but is not being operated from Sidney workings. Preliminary work done by Sidney under an operating, profit-sharing agreement with **Nabob Silver-Lead Company** included installation of an electric hoist and 6,400 feet of electric cable, repairing mine equipment, and unwatering the Nabob shaft. Nabob had blocked out an ore body estimated at more than 100,000 tons before suspending operations two years ago because of low zinc-lead prices.

Golconda Lead Mines Company is treating about 6,000 tons of ore monthly at its custom mill east of Wallace, Shoshone County, Idaho. Most of the ore is from the **Lucky Friday** mine. Reopening of the **Golconda** mine awaits better prices for lead and zinc. Seven thousand shares of **Hecla Mining Company** stock have been purchased as an investment. **Golconda** also owns 155,000 shares of **Lucky Friday Silver-Lead Mines Company** stock. H. F. Magnuson, Wallace, vice president and treasurer, is acting head of the **Golconda** firm.

J. R. Simplot Company has announced that it plans to build a 200-ton-per-day sulphuric acid plant at a cost of \$2,000,000 in Pocatello, Idaho. This will give the firm an integrated operation; formerly its acid requirements were purchased from the **Bunker Hill Company** at Kellogg. Simplot has extensive deposits of phosphate in the Blackfoot area, and will purchase sulphur recovered as a byproduct

of Wyoming oil to manufacture the treble superphosphate.

Calera Mining Company expects to shut down its cobalt operations in Lemhi County, Idaho completely by the end of June unless the government resumes its purchasing for the national stockpile. Underground operations have already been abandoned in favor of the cheaper open-pit method. The Garfield, Utah refinery could operate until July on stockpiled concentrates.

Abot Mining Company, organized two years ago to consolidate several properties in the Hunter mining district of Shoshone County, Idaho, is expected to start development work this summer. Operations would be carried out from the **Gold Hunter** mine shaft, rehabilitated by **Day Mines, Inc.** Holdings of the Abot firm now comprise 36 mining claims adjacent to **Gold Hunter**. Merged properties are **Pilot Silver Lead Mines**, **Hunter Silver-Lead Mines**, and the **Alma** and **Homestake** groups and the **Eisenhower Fraction** formerly owned by **Day Mines**. Henry L. Day, Wallace, heads both **Day Mines** and **Abot**.

OREGON

Three government agencies have applied for withdrawal of land in Oregon, totaling a little more than 4,000 acres. All withdrawals are subject to valid existing rights and all would prevent location of mining claims under the general mining laws. The U.S. Bureau of Reclamation requests 3,917 acres for use in proposed redevelopment of the Lower Grande Ronde and Catherine Creek areas of the Grande Ronde Project; the U.S. Department of Agriculture desires land for the Sunshine Bar Recreation Area; and the U.S. Bureau of Sport Fisheries and Wildlife is seeking land for the Oregon State Game Commission in order to develop and provide public access to the Wallowa River for fishing, in connection with the Wallowa River Wildlife Management Association.

MONTANA

American Machine and Metals, Inc. has formed a subsidiary, **Trout Mining Company**, to handle the parent company's mining interests. This would include the historic **Granite Bi-Metallic** mine which **Trout Mining Division** had taken over last year, and the **Trout** mine and mill at Phillipsburg, Montana.

Anaconda Company at Butte, Montana reportedly is developing an electric truck for use in its **Berkeley** pit. Production in the reduction department of the firm's Great Falls plant has been increased by the resumption of operation for a sixth zinc unit. The refinery had curtailed operations a year ago because of the unstable zinc market conditions. At that time, the operation was cutback from eight operating units to five.

A proxy fight is underway by a group of stockholders to secure control of **Goldfield Consolidated Mines Company**. Goldfield owns 65 percent of **American Chrome Company** with properties at Nye, Montana. The present management has proposed a merger between the two firms.

In the January issue of **MINING WORLD**, it was reported that a Montana trial judge had ordered all property of **Montana Gold and Chemical Company** sold at public auction. The lawsuit was settled, however, to the satisfaction of the plaintiff, Kenneth C. Davis.

WASHINGTON

Drilling by **Dawn Mining Company** in the Spokane Indian Reservation of southwestern Stevens County, Washington has extended known uranium ore bodies and substantially increased proven ore reserves. Production at the **Midnite** mine and adjoining **Boyd** lease has been running about 16,000 tons of ore monthly. A total of 191,265 tons of ore was mined and 654,619 tons of waste stripped in 1958. Dawn's uranium processing plant at Ford, at the eastern entrance to the reservation, treated 161,280 tons of uranium ore during the year. Dawn is 51 percent owned by **Newmont Mining Corporation** and 49 percent owned by **Midnite Mines, Inc.** of Wellpinit, Washington.

A 500-foot inclined shaft has been completed at the **Grandview** mine in the Metaline mining district of Pend Oreille County, Washington, by **American Zinc, Lead and Smelting Company**. The shaft gains 150 feet of additional depth on the **Grandview** ore body. An estimated 400 feet of tunneling from the new 650 working level will reach the ore zone. The inclined shaft is 3,000 feet from the bottom of the main operating vertical shaft. Forty-two men are engaged in mining and milling operations under John W. Currie, resident manager.

Daybreak Uranium, Inc. has been carrying on negotiations with a large Canadian concern for operation of its Spokane area uranium holdings on a profit-sharing basis.

Kaiser Aluminum & Chemical Corporation has closed down one of seven potlines operating in its Mead, Washington reduction plant. The plant has had a total of eight potlines in that plant, each producing 22,000 tons annually. The cutback was made "to adjust to plant inventories of primary aluminum." Earlier the company had reduced production at its Trentwood, Washington fabricating plant because of a midwinter reduction in customer requirements. The Mead plant supplies Trentwood. Mead's capacity will now be 132,000 tons annually.

Silica from a deposit near Okanogan, Washington is being shipped to **Keokuk Electro-Metals** plant at Rock Island, Washington for alloy production. **Pacific Silica Company** of Seattle is developing the deposit by open-pit methods. The material is crushed and washed at Okanogan before being shipped to the Keokuk plant.

precipitates—ROCKY MOUNTAIN

COLORADO

The Du Pont Company has acquired mining claims and mineral rights over 4,500 acres of land in the White Earth mining district of Gunnison County, Colorado. The property includes 24 patented lode claims, 30 unpatented lode claims, and 6 unpatented placer claims. Du Pont's interest is in the columbite-bearing carbonatite deposits on the property which are believed similar to several deposits in Africa and South America. The ore is reported to be of variable grade with reserves estimated at 100,000 tons of columbite oxide. According to company spokesmen, the firm has no immediate plans for mining. Present pilot plant production can be sustained from outside commercial sources. Some of the mineral rights acquired had been held by Humphreys Gold Corporation.

The Third Symposium on Rock Mechanics, sponsored jointly by the departments of mining engineering at the Colorado School of Mines, the University of Minnesota, and the Pennsylvania State University, will be held on April 20 through 22 at the Colorado School of Mines, Golden, Colorado. Themes of the four sessions will be: factors common to comminution, underground failures, and failures resulting from explosions; factors common to soil mechanics and rock failures; seismology and explosions; and nuclear blasts in mining.

The U.S. Atomic Energy Commission at Grand Junction, Colorado has terminated its service contract with the Swinerton and Walberg Company of San Francisco as of April 30, 1959. The contract was due to expire on June 30, but contained a termination clause permitting earlier expiration. The government believes a single contractor—namely Lucius Pitkin Inc., which conducts ore buying and concentrate receiving functions for the Grand Junction Operations office—can handle both jobs. The Lucius Pitkin contract, a cost plus fixed fee type, is being extended for one year from June 30, 1959 to June 30, 1960, with an option to extend yearly to June 30, 1962.

Frank Richardson of Ouray, Colorado is planning to install a small mill at his Brooklyn mine near Silverton, Colorado this coming season. Last season he did considerable repair work at this old mine and built a new access road. He also owns the famous Little Fannie lead-silver mine.

SOUTH DAKOTA

In 1958 Homestake Mining Company mined and milled the greatest quantity of ore ever handled in the company's history—1,725,081 tons. Unit costs were slightly reduced and the output per man increased, because of the larger tonnage handled and the continued technical improvements in the mine and plants. Gold production from the Homestake mine (South Dakota) was 558,943 ounces, valued at \$19,611,351, which for the

third year was close to the all-time high attained in 1939. Grade of ore mined was lower. Ore reserves as of January 1, 1959 were estimated at 13,173,500 tons with grade of \$12.26 per ton; on January 1 1958, ore reserves were 14,123,550 with a grade of \$12.22. No new ore blocks were added to the reserves in this period. The company expects tonnage available above the 5000 level will be substantially higher than current operating estimates. Development work below the 5000 level, however, has proved disappointing. Ore has been found, some high grade, but not in quantity or in places that justify assuming continuity of specific ore bodies between levels or their inclusion in estimates of developed ore.

According to Mines Development Inc., owners and operators of Edgemont, South Dakota uranium mill, measured ore reserves in the Black Hills region are now estimated at 1,000,000 tons. In the past two years, substantial discoveries of ore have been made in the Southern Hills area of South Dakota and in north-eastern Crook County in Wyoming. Significant discoveries have been made by Homestake Mining Company, Montana Chemical & Milling Corporation, Pictograph Mining and Uranium Company Inc., Giant Cycle Corporation, B and H Mines, and the Chord Uranium Company. The 1,000,000-ton figure does not include the uraniferous lignites of northwestern South Dakota and southwestern North Dakota, which cannot be processed at Edgemont.

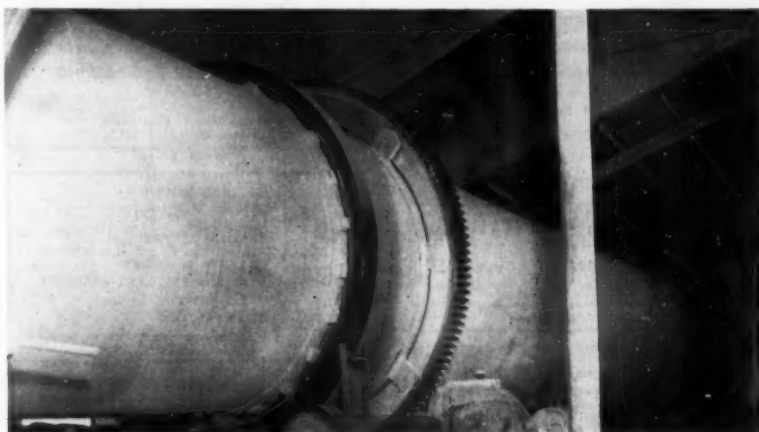
UTAH

Two Utah firms have joined with Cerro de Pasco Corporation in exploration of the old Holt silver property, six miles

north of Enterprise, Utah. A 250-foot, two-compartment shaft is being sunk, and drifts will be driven from the shaft to explore the area. Some surface drilling is already under way. Arnet Company of Salt Lake City and Chief Consolidated Mining Company of Eureka are the two Utah participants. Arnet was formed by Samuel S. Arentz who purchased the property in 1958 from the Church of Jesus Christ of the Latter Day Saints. The mine is said to date back to 1896 when the deposit was discovered by a prospector named Holt. The only mining seems to have been done in the 1930's by a Cincinnati group. If reserves prove promising, the companies may construct a cyanide reduction plant.

Kennecott Copper Corporation's new 18,000-foot-long tunnel has been completed at the Bingham mine of Utah Copper Division. Work was started in October 1956 and completion was planned for 1960 but Utah Construction Company drove the tunnel in record time. The \$11,000,000 tunnel is located at the 5,490-foot level, and will not be used until the bottom of the pit reaches that level. It will then connect the pit bottom with the Copperton yards at the mouth of the canyon. The tunnel is expected to reduce mining costs by eliminating uphill haulage of ore and waste. The pit also has two other tunnels at the 6,040 and 5,840 levels.

Regular shipments of uranium ore have started from the property of Shattuck Denn Mining Corporation in San Juan County, Utah. Last year, the firm acquired the Velvet property from Kerr-McGee Oil Industries and Anderson Development Corporation. The Bardon 850-foot shaft was then sunk in record time (see MINING WORLD, December 1958, pages 37-39). Initial ore production indicated a uranium grade of 0.45 to 0.50 percent U_3O_8 which is comparable with the average grade of ore produced by other leading mines in the Big Indian district.



Wyoming Bentonite Plant Uses Standard Dryer

Wyo-Ben Products Company north of Greybull, Wyoming has installed an 8-foot-diameter by 64-foot-long Standard Steel Corporation dryer which has a designed capacity of 250,000 tons of bentonite per year, removing 17 percent moisture from the crude material. Wyo-Ben mines a pure Wyoming grade bentonite, which is a colloidal clay formed from airborne volcanic dust deposited on ancient inland seas. It is sold and used in large quantities for oil well drilling mud, an additive for oil well cementing, foundry, chemical and reclamation purposes. The company's mineable reserves are estimated at more than 15,000,000 tons.

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Superior Oil Company appears to have encountered a major potash deposit in the Lisbon Valley area of San Juan County, Utah. The beds seem to continue to depths of between 2,000 and 2,200 feet. Several additional holes will be drilled to prove the reserves. The company's property is in Section 10, Township 30 South, and Range 25 East. Work has been done under federal prospect permits but the company is now converting the permits to regular leases.

Fifteen patented phosphate claims in the Crawford Mountains in Utah have been acquired by San Francisco Chemical Company from the U.S. Phosphate Company. The company reportedly plans to develop the new properties through the Cherokee mine crosscut.

Western Contrasting Corporation of Sioux City, Iowa is striving to move 1,000,000 yards of material a month from the upper east and west sides of the Bingham Canyon copper mine of Kennecott Copper Corporation's Utah Copper Division. The firm's stripping contract with Kennecott calls for removal of 8,000,000 yards of waste from the upper levels. Western hopes to complete the work by the end of July.

White Canyon Mining Company has had to lower its ore reserve estimates in the last few months, and a \$141,000 drilling exploration program did not reveal additional deposits. The company plans to mine out the existing ore, and has already staked out new areas in San Juan County, Utah which appear favorable for uranium production. The firm is also continuing to take under option any other likely leases for exploration. Texas-Zinc Minerals Corporation is a stockholder.

A new mining and manufacturing firm, Utah Cellulose & Chemical Company, has been incorporated in Salt Lake City, Utah. Officers include James L. Barker, Jr., president; Arlin Davidson, vice president; P. G. Smith, secretary-treasurer.

Triangle Mining & Milling Company has been incorporated at Salt Lake City, Utah by Lionel M. Farr, president; C. Allen Elggren, vice president; and D. Howe Moffatt, secretary-treasurer.

WYOMING

Homestake Mining Company reports that total ore reserves in the Hauber mine in northeastern Wyoming have been increased to 419,000 tons containing 0.29 percent U_3O_8 , and further extensions are expected. A 400-foot shaft has been sunk on the property which is actually the Hauber Ranch, 40 miles north of Moorcroft in Crook County. Some 2,287 feet of drilling had been completed by the end of last year. The ore bodies are reported to be some 100 feet below the water table, which creates certain difficulties.

The U.S. Atomic Energy Commission has approved a new milling contract with Western Nuclear Corporation, doubling the firm's milling capacity at its mill at Jeffrey City, Wyoming. The action was the first in the long-negotiated contract plans to either increase capacities or establish them with five uranium firms in the state. Western Nuclear's ton-per-day capacity would be increased from 410

to 845 under the new contract, which is to go into effect July 1. With the announcement of the contract approval, the corporation's president, Robert Adams of Rawlins, Wyoming, announced a \$7,000,000 expansion and financing plan. After retiring the firm's present debt with \$2,750,000, the remainder will be distributed as follows: \$1,000,000 for expansion of the firm's uranium mill; \$1,500,000 for mine development; and \$1,750,000 for working capital. Western-Knapp Engineering Company of San Francisco has received the contract for the \$1,000,000 plant addition.

The U.S. Bureau of Land Management has granted a right-of-way for Columbia-Geneva Steel Division of U.S. Steel Corporation to build a railroad from its Taconite iron ore reserves in the Atlantic City, Wyoming area, to a point near Rock Springs, Wyoming, where it would join the Union Pacific Railroad. The steel firm will pay \$345 a year rental and has agreed to protect grazing in the area as well as to maintain all approaches and crossings. The track would be used only by Columbia-Geneva, to transport its taconite concentrate from the area to its steel mill at Provo, Utah. The right-of-way is 100 feet wide and 55 miles long. Columbia-Geneva still has not given any official indication as to when it would begin actual construction work on the proposed project.

Western Knapp Engineering Company of San Francisco will build Federal Uranium Corporation's proposed 522-ton-per day mill in the Gas Hills area of west central Wyoming. The \$3,000,000 project is to be started in April, with completion slated in December. The mill site is about 50 miles east of Riverton, Wyoming. Associated with Federal in the venture are Gas Hills Uranium Company, headed by Cotter W. Ferguson of Casper, Wyoming, and Radorock Resources, Inc. of Salt Lake City, a Federal subsidiary. The new mill will also process custom ores of other firms, as well as deposits owned by Federal and its associates.

The Fourth Annual Convention of the Wyoming Mining Association will be held in Riverton on April 17 and 18. The program will emphasize uranium mining and milling practices. There will be an opportunity to visit the three uranium mills and the numerous mining operations in the area. Write to PO Box 1230 at Riverton for further information.

Intermountain Chemical Company, an affiliate of Food Machinery and Chemical Corporation and National Distillers and Chemical Corporation, is completing a 20 percent increase in production facilities near Green River, Wyoming. The treatment plant will be increased 70,000 tons to produce 470,000 tons of high-grade soda ash annually. Through refining of the trona ore, the company is able to produce a 99.2 percent pure soda ash product.

Vipont Gypsum Corporation, a wholly-owned subsidiary of Vipont Mining Corporation, has been organized to develop a gypsum deposit on the Wind River Indian Reservation in Fremont County, Wyoming. According to Alfred E. Ellerby, president, 20,000,000 tons of gypsum have been blocked out in the area. The company hopes to eventually build a plant to process wallboard and other gypsum products.

FLYGT

"ON OUR GRANTS, NEW MEXICO, WORK FLYGT PUMPS ARE THE ONLY PUMPS WHICH CAN DO THE JOB" reports Boyles Bros. Drilling Co.

Well-known as mining contractors, engineers and geologists, Boyles Bros. Drilling Co. are sinking a variety of shafts in the famous Ambrosia Lake uranium district near Grants, New Mexico. The roster of Boyles Bros.' customers includes leading names in the mining and petroleum industry—firms which demand efficient equipment to obtain top performance. When it comes to de-watering, Boyles Bros. depend on Flygt Submersible Electric Pumps.

Boyles Bros.' Mr. Victor L. Stevens, in his own words, puts it this way: "We have on our shaft jobs in Grants, New Mexico, 3 Flygt B-150s and 9 Flygt B-80s, and these pumps are solving the big problem in the Grant's area, which is abrasive sand particles wherever water is encountered.

"We are using the Flygt B-150s and B-80s to handle a good part of our water, and they are very successful pumps. We feel that Flygt pumps are the only pumps that we know can do our job.

"We are concreting as we sink some of the shafts. When we hit water a lot of the cement washes out of the concrete lining and it is handled by the Flygt pumps. Where we were cement grouting off the water, a large amount of the cement went into the shaft and was pumped out by the Flygt Pumps," Mr. Stevens concludes.

FLYGT SUBMERSIBLE ELECTRIC PUMPS range in size from 1½"-85 GPM capacity to 8"-3000 GPM capacity. Head capacities range up to 210 feet. Higher heads obtainable with FLYGT PUMPS in tandem. Weights range from 70 to 1200 pounds. Write for complete specifications.

CHECK THESE FLYGT FEATURES

- ✓ Electric, fully submersible, fully portable.
- ✓ Instant pumping—no priming, no installation.
- ✓ Runs dry without damage, resistant to salt water.
- ✓ Takes a high proportion of solids, frost and fire-proof.
- ✓ Practically no maintenance or supervision.
- ✓ Operates unattended, quick and easy to service.



ASK FOR THE NAME OF YOUR NEAREST FLYGT DEALER

FLYGT

WEST OF THE MISSISSIPPI

EAST OF THE MISSISSIPPI

Stenberg
MFG. & SALES INC.

1646 Ninth St.
(Corner of Olympic & Ninth)
Santa Monica, California

STENBERG MANUFACTURING CORPORATION

Hoosick Falls, N.Y.

U.S.A. Metal & Mineral Prices

METALS

MARCH 24, 1959

COPPER: Electrolytic. Delivered F.o.b. cars, Valley basis (pound)	31.50¢
Lake. Delivered, destinations, USA	31.50¢
Foreign. Delivered Destinations, USA	31.50¢
Custom	34.00¢
LEAD: Common Grade. New York (Per pound)	11.50¢
Tri-State Concentrate, 80% lead, per ton	\$134.52
ZINC: Prime Western: F.o.b. E. St. Louis (Per pound)	11.00¢
Prime Western: Delivered, New York	11.50¢
Tri-State Concentrate, 60% zinc, per ton	\$64.00
ALUMINUM: Primary 30 Pound Ingots (99% plus) (Per pound)	26.80¢
ANTIMONY: Lone Star Brand. F.o.b. Laredo, in bulk (Per pound)	29.50¢
BISMUTH: (In ton lots) price per pound	\$2.25
CADMIUM: Sticks and bars. 1 to 5 ton lots (Price per pound)	\$1.45
COBALT: 97.99%, keg of 550 pounds (Price per pound)	\$1.75
COLUMBIUM: Powder. Nom., per pound	\$55.00-\$85.00
GERMANIUM: Germanium dioxide, high purity, gram	18.50¢
LITHIUM: 98% (per pound)	\$11.00-\$14.00
MAGNESIUM: Ingots (98.8%) F.o.b. Valasco, Texas, per pound	36.00¢
MERCURY: Flasks. Small lots, New York	\$230.00-\$232.00
NICKEL: "P" Ingots (5 pounds). F.o.b. Port Colbourne, Ontario	75.50¢
PLUTONIUM: To July 1, 1962 AEC will pay \$30.00 to \$40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram	\$30.00
SELENIUM: 99.5%, per pound	\$7.00
THORIUM: per kilogram	\$43.00
TIN: Grade A Brands. New York (Per Pound) Prompt delivery	\$1.026
TITANIUM: 99.3% + Grade "A" Sponge (Per pound)	\$1.70-\$1.82
URANIUM: Red (0.790 U-235) \$16.00 Per Pound; Foil	\$16.75
U-235: Nominal (Per pound)	\$7.725
GOLD: United States Treasury Price	\$35.00 per ounce
SILVER: Newly mined domestic. U.S. Treasury price per ounce	90.5¢
Foreign Handy Harmon	91.3¢
PLATINUM: Per ounce	\$77.00-\$80.00
ZIRCONIUM: Sponge, Per pound, Reactor Grade	\$5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: 10 to 12% BeO. F.o.b. mine, Colorado \$46.00 per unit	
Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at \$400.00 per short ton or by assaying at: 8.0 to 8.9% BeO, \$40 per unit; 9.0 to 9.9% \$45; over 10.0% \$48.00.	
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons	
African (Rhodesian). 48% Cr ₂ O ₃ . 3 to 1 Ratio	\$42.00-\$44.00
African (Transvaal). 48% Cr ₂ O ₃ . No ratio	\$30.00-\$32.00
Turkish, 48% Cr ₂ O ₃ . 3 to 1 chrome-iron ratio	Nominal \$50.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.	
COLUMBIUM-TANTALUM ORE: Per Pound Pentoxide Nominal \$1.00	
IRON ORE: Lake Superior. Per gross ton Lower Lake Ports	
Mesabi, Non Bessemer, 51.3% Fe	\$11.45
Mesabi, Bessemer, 51.3% Fe	\$11.60
Old Range Non Bessemer	\$11.70
Old Range Bessemer	\$11.85
Swedish, Atlantic Ports, 60 to 68% Fe Contracts. Per Unit	\$26.00¢
MANGANESE ORE: Metallurgical grade. 48 to 50% Mn. Long ton unit	\$1.00-\$1.05
Metallurgical grade. 46 to 48% Mn. Long ton unit	\$0.95-\$1.00
Metallurgical grade. 44 to 46% Mn. Long ton unit	\$0.85-\$0.90
Domestic U.S. Government. Small lot program f.o.b. railroad cars, minimum 40%. Base (48%) \$2.30 per unit with premiums and penalties.	
MOLYBDENITE CONCENTRATE: 90% MoS ₂ F.o.b. Climax, Colorado. Per pound Mo, plus container cost	\$1.25
TUNGSTEN CONCENTRATE: Domestic. 60% WO ₃ Per short ton unit	Nominal \$21.00
Foreign. 65% WO ₃ Per short ton unit (Scheelite)	Nominal \$14.00
Foreign: South American, Spanish, Portuguese	Nominal \$13.00
URANIUM ORE: F.o.b. purchase depot or company mill in accordance with AEC schedules and company buying contracts. Basic price is \$1.50 per pound of U ₃ O ₈ in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums, penalties where applicable.	

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum 4.25 specific gravity, per short ton	\$16.00
BENTONITE: Minus-200-mesh. F.o.b. Wyoming. Per ton, car-load lots	\$12.50
Oil Well grade. Packed in 100 pound paper bags	\$14.00
BORON: Technical grade	F.o.b. Boron, California. Per ton \$47.50
FLUORSPAR: Metallurgical grade. 72.5 % effective CaF ₂ content per short ton F.o.b. Illinois-Kentucky mines	\$36.00-\$40.00
Mexican. 70% F.o.b. border	\$26.00-\$27.00
Acid Grade. 97% CaF ₂ Bulk, F.o.b. mine	\$48.00-\$52.00
PERLITE: Gravel. F.o.b. mine per short ton	\$3.00 to \$5.00
Plester grades. Crushed and sized. F.o.b. plant	\$7.00 to \$9.00
SULPHUR: Long ton, F.o.b. Hoskins Mound, Texas	\$25.00
Export	\$24.00-\$25.00


LONDON METAL AND MINERAL PRICES

March 24, 1959

Per Long Ton USA Equivalent cents per pound¹

COPPER: Electrolytic spot	£249	10s Od	31.19¢
LEAD: Refined 99%	£ 69	5s Od	8.66¢
ZINC: Virgin	£ 75	10s Od	9.44¢
ALUMINUM: Ingot, 99.5%	£180	0s Od	22.50¢
ANTIMONY: Regulus, 99.6%	£197	10s Od	22.69¢
TIN: Standard, 99.73%	£781	10s Od	97.69¢
TUNGSTEN: Long ton unit	88s		\$12.32
1. With Sterlink			Pound at \$2.80

Quotations on metals and certain ores through the courtesy of American Metal Market, New York, N. Y.



MORE tons per load
MORE trips per hour

... mean bigger profits for YOU!



Low rear-entry and wide bowl provide easy target for shovel operator . . . permit fast swing-out of dipper, let operator heap maximum yardage fast, with minimum spillage.



At touch of electric dashboard switch, body lifts, swings low behind rear wheels . . . dumps clean over bank's edge. On soft fills, Rear-Dump can pull out without wheel-spin. Operator "walks" unit free with electric kingpin-steer . . . or "humps" it out by varying wheel-base through use of electric hoist-motor and alternate use of front and rear wheel brakes.

The 35-ton (23-yd.) LeTourneau-Westinghouse B Tournapull® Rear-Dump lets you load and haul *big* loads anywhere. And with speeds to 34 mph, this high-production, off-road hauler delivers more material per shift! Here's why:

Greater maneuverability

Big "B" makes continuous 180° turn in space only 35' wide . . . in dump position, in just 27'. This unusual maneuverability lets you work in restricted quarters where conventional haulers often cannot go. You spot quicker at the shovel, dump faster, move more loads per day.

In addition, big *load-rated* tires let Rear-Dumps always take the shortest route—over pavement, rocky pit-floors, rough haul-roads, RR tracks, cross-country, or through muck and over soft fills. Time saved adds up to extra trips per shift.

Fast, easy loading

B Rear-Dump's large target (15'4" long, 10'2" wide) permits fast, easy loading without spillage. Open rear of body permits quick bucket swingout, while dipper door is still open. Because it minimizes loading time, big 35-ton Tournapull Rear-Dump gets more loads per hour, earns bigger profits per day.

Dumps fast, clean

Flick of dashboard switch instantly activates point-of-action electric hoist-motor. Body raises quickly to desired angle. At full dump position, trailing edge of bowl is low behind rear wheels . . . so material cannot roll forward to lodge against wheels, nor pile under rear end. Streamlined body sheds stickiest material readily.

Safe, positive control

with big brakes, electrotarder

Multi-disc air brakes on all 4 wheels provide 7,488 sq. in. of braking surface—permit quick, safe control with heaped load, on any grade, in any weather. Electrotarder gives additional *non-wearing* braking action, through resistance on generator. Parking brake, and automatic emergency braking system, are standard.

Interchangeable work units

Behind the same basic 335-hp B Tournapull prime-mover, the faster-loading 28-yd. Fullpak scraper, or 30-ton Crane, can be readily interchanged. For a small additional investment, these trailing units can help keep your Tournapull profitably busy the year-around. Available with Cummins or General Motors diesel engines. Write for complete details.

Tournapull—Trademark Reg. U.S. Pat. Off.
BR-1534-G-1r



LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

FLYGT

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FLYGT

WEST OF THE MISSISSIPPI:

EAST OF THE MISSISSIPPI:

Stancos
—MFG. & SALES INC.—

1446 Ninth St.
(Corner of Olympic & Ninth)
Santa Monica, California.

STENBERG MANUFACTURING CORPORATION
Hoosick Falls, N.Y.

U.S.A. Metal & Mineral Prices

METALS

MARCH 24, 1959

COPPER: Electrolytic. Delivered F.o.b. cars, Valley basis (pound)	31.50¢
Lake, Delivered, destinations, USA	31.50¢
Foreign, Delivered Destinations, USA	31.50¢
Custom	34.00¢
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Tri-State Concentrate, 80% lead, per ton	\$134.52
ZINC: Prime Western: F.o.b. E. St. Louis (Per pound)	11.00¢
Prime Western: Delivered, New York	11.50¢
Tri-State Concentrate, 60% zinc, per ton	\$64.00
ALUMINUM: Primary 30 Pound Ingots (99% plus) (Per pound)	26.80¢
ANTIMONY: Lone Star Brand, F.o.b. Laredo, in bulk (Per pound)	29.50¢
BISMUTH: (In ton lots) price per pound	\$22.50
CADMIUM: Sticks and bars, 1 to 5 ton lots (Price per pound)	\$1.45
COBALT: 97.99%, keg of 550 pounds (Price per pound)	\$1.75
COLUMBIUM: Powder	Nom., per pound \$55.00-\$85.00
GERMANIUM: Germanium: dioxide, high purity, gram	18.50¢
LITHIUM: 98% (per pound)	\$11.00-\$14.00
MAGNESIUM: Ingots (98.8%) F.o.b. Valasco, Texas, per pound	36.00¢
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SELENIUM: 99.5%, per pound	\$7.00
THORIUM: per kilogram	\$11.00
TIN: Grade A Brands, New York (Per Pound) Prompt delivery	\$1.02¢
TITANIUM: 99.3% + Grade "A" Sponge (Per pound)	\$1.70-\$1.82
URANIUM: Rod (0.790 U-235) \$16.00 Per Pound; Foil	\$16.75
U-235: Nominal (Per pound)	\$7.725
GOLD: United States Treasury Price	\$35.00 per ounce
SILVER: Newly mined domestic, U.S. Treasury price per ounce	\$19.5¢
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CHROME ORE: F.o.b. railroad cars eastern seaports, Dry long tons	
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Turkish, 48% Cr ₂ O ₃ , 3 to 1 chrome-iron ratio	Nominal \$50.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.	
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IRON ORE: Lake Superior, Per gross ton Lower Lake Ports	
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Oil Well grade. Packed in 100 pound paper bags	\$14.00
BORON: Technical grade	F.o.b. Boron, California, Per ton \$47.50
FLUORSPAR: Metallurgical grade, 72.5 % effective CaF ₂ content per short ton F.o.b. Illinois-Kentucky mines	\$36.00-\$40.00
Mexican, 70% F.o.b. border	\$26.00-\$27.00
Acid Grade, 97% CaF ₂ , Bulk, F.o.b. mine	\$48.00-\$52.00
PERLITE: Crude: F.o.b. mine per short ton	\$3.00 to \$5.00
Plaster grades. Crushed and sized, F.o.b. plants	\$7.00 to \$9.00
SULPHUR: Long ton, F.o.b. Hoskins Mound, Texas	\$25.00
Export	\$24.00-\$25.00

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March 24, 1959

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ZINC: Virgin, 98%	£ 75	10s Od 9.44¢
ALUMINUM: Ingot, 95.5%	£180	0s Od 22.50¢
ANTIMONY: Regulus, 95.5%	£197	10s Od 22.69¢
TIN: Standard, 99.75%	£781	10s Od 97.69¢
TUNGSTEN: Long ton unit	88s	\$12.32
1. With Sterilink		Pound of 2.80

Quotations on metals and certain ores through the courtesy of American Metal Market, New York, N. Y.

MORE tons per load
MORE trips per hour

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Low rear-entry and wide bowl provide easy target for shovel operator . . . permit fast swing-out of dipper, let operator heap maximum yardage fast, with minimum spillage.



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Tournapull—Trademark Reg. U.S. Pat. Off.
BR-1534-G-1r



LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Newsmakers in International Mining



EDILBERTO A. CABIGAS, head of Cabigas Mining Enterprises, Philippines, recently signed a contract with Surigao Consolidated Mining Company for operations of Cabigas' high-grade iron property located in Pagadian, Zamboanga del Sur. Shown above at the signing of the contract are (left to right): **OTTO F. WEBER**, president and general manager of Surigao; **JOSE A. BETS**, purchasing agent, Surigao; **MR. CABIGAS**; and **PLACIDO ADAD**, treasurer of Surigao Consolidated.

L. W. Adshead, manager of the President Steyn Gold Mining Company Ltd. mine in the Union of South Africa, has been transferred to the East Daggafontein Mines Ltd. mine as manager. He succeeds **N. G. Harper** who is retiring. **G. Thorburn**, assistant manager at the President Steyn mine, has been appointed manager.

C. G. Carlstrom of Luossavaara Kiirunavaara AB, Malmberget, Sweden, moved from Malmberget to LKAB's head office in Stockholm, where he is occupied with the harbors in Lulea and Narvik.

W. S. Findlay has been appointed director of the South African Minerals Corporation Ltd. Mr. Findlay succeeds **A. S. Thomas**, who has resigned.



ALFRED D. ROOD (left), formerly with The Anaconda Company's mining department, has been named assistant to the vice president of Andes Copper Mining Company and Chile Exploration Company, subsidiaries of The Anaconda Company. Mr. Rood succeeds **DOUGLAS M. DUNBAR** (right), who has retired. A graduate of Michigan College of Mining and Technology, Mr. Rood has been associated with mining operations of Anaconda and its affiliates since 1925 at properties in Arizona, Montana, and Petrarillas, Chile. He has been in the New York City headquarters of the company since 1957. Mr. Dunbar, who has been with the Anaconda subsidiary for 39 years, joined the Chile Exploration Company in 1919 as a mine engineer in Chuquicamata, Chile.

Johnston Avery, president of Liberian-American-Swedish Minerals Company, recently returned to the United States from the company's operations in Monrovia, Liberia.

Sverre Wee is leaving Lima, Peru for Monrovia, Liberia, where he will be resident harbor engineer at Liberian-American-Swedish Minerals Company iron ore project there.

W. E. Frith has been appointed director of the Union Platinum Mining Company, Ltd. in the Union of South Africa.

W. T. H. Cairns, assistant to Rio Tinto's technical manager, has been inspecting mining operations in South Africa and the Central African Federation.

Gunter J. Bilstein, mining engineer formerly with Corporation Comercial Sudamericana in Lima, Peru, has moved to Los Altos, California, U.S.A.

Sigvard Ando has moved from Boliden, Sweden to the head office of Boliden Gruv AB in Stockholm to be assistant to Mr. Noren, general manager.

Alexander W. Edelen, manager of Minera Mexcala S.A. at Tercer Piso, Mexico, recently moved to Mexico City where he will be a consulting engineer.

I. Pousette, Bolidens Gruv AB, has moved from Adak to the central staff in Boliden, Sweden.

H. Bertil Noren, vice president of Boliden Gruvaktiebadag, Sweden, has inspected mining and metallurgical plants throughout southern Africa.

L. Steyggers, consulting engineer, and **J. Lichtherte**, smelter manager of Union Miniere du Haut-Katanga, Belgian Congo, recently visited metallurgical plants in South West Africa and the Northern Rhodesian copperbelt.

Y. G. Wahba is plant engineer at King Solomon copper mine at Tinma, Israel. This mine is owned by Israel Mining Industries.

Earle V. Dempsey recently resigned from his position with the Chile Exploration Company in Chuquicamata, Chile.

Three senior mining appointments have been announced by the Consolidated Mining and Smelting Company of Canada at Trail, British Columbia. **B. E. Hurdle** was promoted from assistant manager of mines to manager of mines, and **L. Telfer** from superintendent of exploration to manager of exploration. **G. N. Moore** is now general superintendent of exploration.

A. J. Brink, manager of Bancroft mine, Bancroft, Northern Rhodesia, has been appointed to the newly created position of general manager.

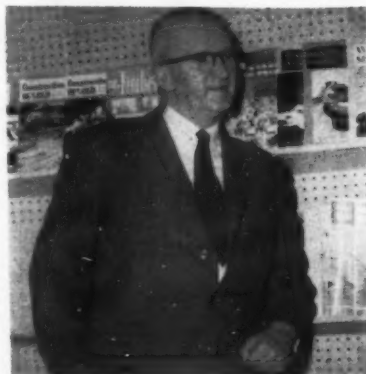
T. Parks, general manager of SELCO, the Canadian subsidiary of Selection Trust, recently inspected Selection Trust interests in Northern Rhodesia.



F. TOWELL (center), assistant smelter superintendent, Braden Copper Corporation, Chile, has been investigating copper smelting methods in the Rhodesian copperbelt. **J. CADLE**, (left), smelter superintendent at Roan Antelope Copper Mines, Ltd., Luanshya, Northern Rhodesia, and **P. HANSEN** (right), assistant smelter superintendent, Roan Antelope Copper Mines Ltd., at Luanshya, Northern Rhodesia, showed Mr. Towell through the smelter, where this picture was taken, during his visit to Roan Antelope operations.

Albert L. Fairley, Jr. has been named president of the Dominion Steel and Coal Corporation, Montreal, Canada. Mr. Fairley, a native of Birmingham, Alabama, was associated with U. S. Steel Corporation's subsidiary, the Tennessee Coal, Iron and Railroad Division, and the United States War Production Board, before joining the Shenango Furnace Company in Pittsburgh, Pennsylvania in 1946. Mr. Fairley served Dominion as executive vice president since 1958.

A.R.C. Fowler has been named consulting engineer at Rand Mines Ltd., Union of South Africa.



S. W. K. MORGAN, research director, Imperial Smelting Corporation Limited, Avonmouth, England, has returned to headquarters following a trip to the United States and Canada. Mr. Morgan received the MINING WORLD award "For the Technical Achievement of 1957," zinc smelting in a blast furnace. During his trip to the United States he visited the West Coast, and zinc smelters in Pennsylvania. In Canada, he visited base metal mining and smelting companies.

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Quebec Cartier To Start Iron Project in Summer

Quebec Cartier Mining Company has received its first eight, 8-yard shovels from Harnischfeger Corporation for use at its Lac Jeannine iron ore project, 150 miles northwest of Seven Islands, Quebec, Canada. These first units will be used in preparation for open-pit mining when operations start this summer. Actual mining is expected to get underway in 1960.

During January, Quebec Cartier announced five new contracts to cover various phases of construction needed to bring the Lac Jeannine deposits into production. These included construction of a deepwater harbor at Port Cartier, east of Shelter Bay; construction of a new town-site near Lac Borbel, 200 miles north of Port Cartier and eight miles from Lac Jeannine; fabrication and erection of shop and maintenance buildings at Lac Jeannine; fabrication and erection of water control gates for Hart-Jaune power project—a 60,000-hp installation, 10 miles south of Lac Jeannine; and a temporary, prefabricated construction camp near mining site.

Quebec Cartier will construct an 8,000,000-ton-per-year concentration plant near the mine. The estimated cost of the entire project is believed to range from \$200,000,000 to \$300,000,000 of which approximately \$120,000,000 will be spent on a 193-mile railroad linking the mine with port facilities to be built at Shelter Bay on the Gulf of St. Lawrence. A joint venture of C. A. Pitts of Canada Ltd. and Foley Brothers of Canada Ltd. will construct the railroad. The Foundation Company of Canada Ltd. has received the general contract for a 60,000-horsepower hydroelectric plant on the Hart-Jaune River.

Peruvian Manganese Find Attracts Foreign Capital

Discovery of reportedly "extensive" manganese deposits in the Perene region of east central Peru has touched off general interest in the area by Canadian and British firms. Cia. Mines de Toronto has already been formed to undertake exploration of the region.

The original discovery was made by Eduardo D. Busso, a Peruvian prospector, who, together with associates, filed claims on approximately 143,000 hectares, located mainly within the Perene land grant of the Peruvian Corporation, a large coffee producer. Mining claims have been filed by the Canadian and British interests on the balance of the colony land and extending over its borders.

Mr. Busso's operations center at Pampa Silva, a few kilometers down river from the coffee plantation center of Pampa Whaley. Exploration work has already uncovered deposits known as Coronel, Sachavaca, and Pampa Tigre. The occurrences lie within the Cretaceous shale, sandstone, and limestone formations common to the Perene region. The ores appear to be of the residual type and were probably derived from weathering of the schists and other original host rocks.

About 60,000 tons of "reasonably assured" ore are indicated, and about 2,000 tons of high-grade manganese exist in the

Sachavaca deposit. Several small shipments made from the latter have proven the grade to be over 55 percent Mn with low silica and phosphorus.

Camagra Begins Work On Guatemalan Mine

The 300-year-old Torlon lead-silver mine near Huehuetanango in northwestern Guatemala is being explored in depth by the Bunker Hill Company of Kellogg, Idaho, lead-silver mining and smelting firm, and W. R. Grace and Company. The joint enterprise has been given the name "Camagra", a combination of Central American Mining Association and Grace.

For 300 years natives have been operating the mine on a small and primitive scale, taking lead and silver from surface workings, none over 100 feet deep. Earliest mining was done for the Spanish conquistadores, at which time an unknown quantity of silver was obtained from the site and lead and zinc were discarded. For the last 50 years, however, it has reportedly been worked for lead and it is estimated that some 50,000 tons have been removed.

After months of preliminary exploration and negotiation, Bunker Hill has undertaken to drive 800 feet of drifts and raises to cut the mineral zone considerably deeper than the present shallow workings. Preparatory work included the building of 12 miles of road between the mine and the nearest city and the construction of living quarters for personnel.

Project manager is Bunker Hill's Robert J. McRae. Charles C. Hathhorn, exploration engineer, and Blaine L. Wiseman, geologist, assisted Mr. McRae in the months of initial exploration. Results of this first phase of Camagra's operations will determine future plans.



FINLAND—The Outokumpu Mining Company will open a new underground mine at Svartoren, Korsnas, in western Finland, with an annual production of about 4,200 tons of lead. The deposit comprises about 1,000,000 tons of lead ore with an average lead content of 4.7 percent. Production is expected to start in 1960. The same firm also plans to develop a pyrite deposit at Pyhajarvi in northern Finland. The deposit contains nickel and zinc, as well as pyrite.

UNITED KINGDOM—Output of tin concentrate at South Crofty mine, located near Camborne, Cornwall, has been increasing and reached 80 tons in January 1959. Output for 1958 totaled 742 tons. A 6-foot by 10-foot rod mill has replaced the old stamp mill. It is designed to take a ¾-inch feed from the heavy media separation plant and reduce it to approximately 20 mesh at a rate of 15 tons per hour. The mill operates in closed circuit with a 4-foot by 8-foot Sherwen screen.

YUGOSLAVIA—The largest lead-zinc mines in Yugoslavia are those at Trepcja, in Serbia. This operation is also the largest Yugoslav exporter of non-ferrous metals. Very favorable results were attained here in 1958. The mines reportedly

exported 52,000 tons of refined lead, 4,000 tons of zinc concentrate, more than 63 tons of silver, and some bismuth and pyrite to European and American markets during the year.

UNITED KINGDOM—The International Tin Council, meeting in London, raised export quotas for the second quarter of 1959 by 3,000 tons to 23,000 tons. This quarter covers the sixth control period under the International Tin Agreement. An understanding is said to have been reached with delegates of the U.S.S.R. whereby the Soviet Foreign Trade organizations will consider exporting only 13,500 tons of tin in 1959 to countries outside the Soviet Bloc, as compared with 18,500 tons in 1958. The dumping of Russian tin on the world market last year nearly exhausted the Buffer Pool manager's financial resources because he is obliged to purchase the metal if the price drops below £730 a ton.

FINLAND—The Imatra Power Company has acquired a five-acre uranium concession at Askola in southern Finland. Further prospecting is necessary before mining operations can be started.

SWEDEN—A three-year modernization program is being undertaken by Riddarhytte A.B. which is expected to increase production of iron ore to 450,000 tons of ore per year. The company has five different production shafts and two concentration plants. They plan a shaft sinking program from the 150-meter level to the 450-meter level. The first 50 meters have already been completed. Ore production will then be centralized in three shafts and concentration in one plant.

EIRE—The chairman of the Silvermines Lead and Zinc Company at Sallee, County Tipperary, has announced that fresh proposals have been received from Cyprus Mines Corporation for the exploration of the Irish properties. These mines were reopened in 1954 and then closed again last year. Diamond drilling at other sections is reported to have disclosed the existence of higher grade ore but proving any ore in substantial quantities would necessitate an extensive and costly exploration program.

POLAND—The Glogow copper deposits, discovered recently on the boundary of Wroclaw and Zielona Gora voivodships, are scheduled for immediate development. The difficult geological conditions which prevail will require considerable cash and material outlays within the next several five-year-plan periods ahead, according to Polish officials, "but the deposit is of great importance to the national economy." Reserves in the older copper deposits are estimated to last another 40 to 50 years, with annual production of about 2,500,000 tons of ore. No production increases in this region are advisable because of the low copper content of the ore. The mines in the "old basin" are expected to reach their full production capacity by 1965, at which time they will produce about 12,000 to 13,000 tons of copper in concentrates, or twice that of present production. Imports will still be needed because the older mines cannot contribute enough to meet the ever increasing demand. Even with doubled output, their share will be very modest, increasing only from 11 percent to 14 percent in the years from 1959 to 1965.

SPAIN—A small group of Catalan (Barcelona) miners will develop the old copper mines near Andujar, capable of



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producing about 1,000 tons per annum. The copper-bearing ore is some 400 feet below the surface. Current demand for copper in Spain runs about 50,000 tons per year, and only about 35,000 tons are available.

YUGOSLAVIA—Intensive work is going on at the Bor copper mine in Serbia, Europe's largest copper mine, to convert the operation to a metallurgical-chemical combine by 1961. Among the important plants being erected are a smelter which will treat increased production from the Bor mine, and also copper concentrate from the new discoveries at Majdanpek, and a sulphuric acid plant which will provide one of the basic raw materials for a new superphosphate plant to be constructed at Prahovo near Bor. Investment in these projects will total about 22,000,000 dinars. When completed, the Bor mine is then expected to produce 30,000 tons of copper, 350,000 tons of pyrite, 230,000 tons of sulphuric acid, 575,000 tons of superphosphate, and large amounts of gold, silver, and steel annually.



AFRICA

UNION OF SOUTH AFRICA—Consolidated African Mines Ltd., which acquired control of a number of small manganese producers in the Postmasburg area, reports that economies effected

through the centralization of operations and administration have enabled the company to meet the prevailing competitive conditions. The firm reports it has been able to show a profit on a restricted output of 3,000 to 4,000 tons a month, while continuing exploratory work. A market has been secured for production of high-grade iron ore, the first shipments of which have already been made.

FEDERATION OF RHODESIA & NYASALAND—Cambishi Mines, a Rhodesian Selection Trust copper property located about midway between Nkana and Nchanga, is to start drilling operations to determine the feasibility of developing this as an open pit, to be followed later by underground mining. A tentative £18,000,000 development plan for the property has been drawn up.

MOROCCO—In order to make Moroccan mineral prices more competitive, the Ministry of Economy has announced a series of special measures, including cheaper power and export tax refunds. Mines will get a 2-franc refund per kilowatt hour on electric power; up to 2,000 francs per ton on coal used in concentrating or smelting ores and between 1,000 and 1,500 francs per ton of oil used for the same purposes; and a 30 percent reduction in the price of Diesel oil used in electricity generating plants at mines which are not connected to the state electricity network. Effective January 1, 1959, the "ad valorem" export tax of 5 percent on lead, zinc, cobalt, and manganese ores or concentrates was reduced to 0.5 percent on a maximum of 6,000 tons of ores or concentrates exported by each mine.

FEDERATION OF RHODESIA & NYASALAND—Nchanga Consolidated Copper Mines Ltd. has started work on a 24-foot-diameter ventilation shaft that will be sunk to an initial depth of 1,500 feet, and later may be increased to 3,000 feet. The final capacity of the shaft will be 1,000,000 cubic feet of air per minute.

SOUTH WEST AFRICA—Tsumeb Corporation Ltd. is building a plant at its mine to process its germanium-bearing concentrates into technical grade germanium dioxide. The plant should be in production early in 1960. In the mine, Tsumeb is preparing to sink an underground vertical shaft below the 30th level in order to develop ore indicated below that level. In the last fiscal year, the firm milled 666,082 tons, averaging 5.66 percent copper, 14.52 percent lead, and 5.51 percent zinc. Assured ore reserves above the 30th level at June 30th, were estimated at 8,848,000 tons, averaging 5.41 percent copper, 13.97 percent lead, 4.33 percent zinc, and 0.016 percent germanium.

UNION OF SOUTH AFRICA—The completed No. 2 Sub-Vertical Shaft System of President Brand Gold Mining Company Ltd. should be commissioned fully in July of this year. With preliminary operations completed, sinking of the No. 3 Shaft System should be in progress in the near future.

GHANA—High gold values have been encountered at Ariston Gold Mines (1929) Ltd. on the 6th level of the South ore body. This reef does not conform to general geological conditions in

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the area, however, and so further work will be undertaken in order to assess the importance of this strike.

NIGERIA—Tin Fields of Nigeria Ltd. suspended operations in the first half of 1958 with the intention of resuming work on the river bed during the 1958-1959 dry season. Now, however, it has been decided preparatory work for re-starting of the gravel pumps would be unjustified in view of the reduction in permitted exports.

UNION OF SOUTH AFRICA—The West German company of Rosenthal Porzellan A.G. has secured rights over high-grade kaolin deposits in the Bitterfontein area, and has secured control over the Union's only porcelain factory near Cape Town. This will now be reopened with an initial output of 70 tons per month.

FEDERATION OF RHODESIA & NYASALAND—Among the difficulties which have been encountered by Bancroft Mines Ltd. has been water in the ore and waste pass systems in the No. 1 shaft area. This has now been alleviated by cementation. Delay in establishing additional stope faces arose when water- and sand-filled fissures were encountered in main haulage development. This has been overcome by turning the haulages into the dry beds underlying the water-bearing conglomerate, and advancing them in those beds rapidly southward. From these haulages, crosscuts to the orebody are being driven at 1,000-foot intervals and from these crosscuts the normal footwall haulages will be started and the area drained. A 12-foot-diameter ventilation shaft to serve the southern area or zone is being sunk. Underground pumping capacity is being raised from 22,400,000 gallons a day to 28,000,000. Underground clarification of water or de-sludging is being effected by hydrocyclones. This has released two of three mud-settling sumps for use as clear-water sumps. A third clear-water sump is being mined.

UNION OF SOUTH AFRICA—Exploratory drilling is underway in the Reitz area of the northeastern part of the Orange Free State, in a zone forming the southeastern rim of the great basin that includes the Witwatersrand goldfields and its extensions, the Klerksdorp and the Odendaalsrus-Sand River fields. Any encouraging disclosures from the Reitz area will contribute important data on the southern extension of gold-bearing conglomerates from the Springs-Nigel-Kinross sector.



BOLIVIA—Two Japanese firms are reported to be planning joint development of a Bolivian copper mine. The Nitto Metal Mining Company, a Japanese copper mining firm, and Dowa Mining Company, operator of mines and smelters, are the companies concerned. Reportedly, they plan to seek Bolivian government approval for the establishment of a new firm to develop the Chacarilla copper mine located on the La Paz-Arica railroad. They propose to supply Japanese equipment to increase the mine's current output of about 300 tons of concentrate

to 1,000 tons monthly, all of which would be shipped to Japan. An Italian group is said to have been interested in the property at one time.

CUBA—Basic Incorporated has leased chrome ore deposits in Camaguey Province and expects to mine them this year if the political situation settles down. The firm has been interested in chrome deposits in Oriente Province for some time, but the revolutionary activities prevented the firm from taking further action on them.

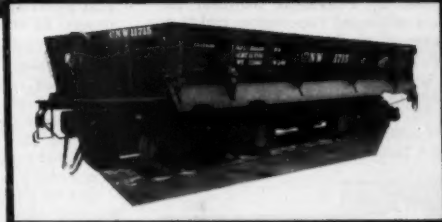
MEXICO—Minera Metalurgica Ancira S.A. is operating a 75-ton flotation mill about 1,500 meters from its El Bastan mine in the Bastan mining district, state of Michoacan. Concentrate assays 32 per-

cent copper, 165 grams silver, and 32 grams gold per ton. The company leases the El Bastan and the Maria Luisa from Demetrio Salgado on a sliding scale royalty basis of from 5 to 10 percent on the net smelter returns. The ore is mixed bornite and chalcopryite containing about 25 percent of the first and 75 percent of the latter. The ore assays from 6.5 percent to 10 percent copper and 1 gram of gold per ton. Roberto Ancira is general manager.

BOLIVIA—A barter arrangement for 5,000 tons of tin in exchange for United States agricultural products has been officially confirmed. The ore will be marketed through Philipp Brothers (4,000 tons) and C. Tennant Sons Company (1,000 tons). These firms are to advance



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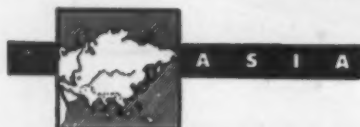
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\$1,250,000 at time of signing of the agreement, and 60 percent at shipment of the ore.

CHILE—Exploration for metallic minerals in Chile has shown a marked increase in the last few months. More attention is being given to gold, silver, and mercury by local interests, and large foreign companies which are at present operating in Chile are stepping up exploration for copper. Interests in iron has increased with the discovery of the El Lago deposit and the new projected direct reduction plant in the Arauco district by the **Krupp Industries** of Germany. This last deposit is a low-grade deposit of cemented magnetite sands south of the city of Concepcion. Rare metals have yet to be properly understood in Chile by the local miners and have been left pretty much alone, in spite of several known deposits of uranium, monazite, and others.

BRAZIL—The Jose Ermirio de Moraes group of Sao Paulo plans to enter the zinc field. The group presently refines nickel through its **Companhia Niquel Tocantins**, and produces aluminum through **Companhia Brasileira de Alumínio**. Now, with an investment of Cr. \$1,000,000,000, it plans to open a zinc reduction plant in the state of Minas Gerais. The area selected is serviced by **CEMIG**, the large state electrical utility company, and so the plant would be assured of sufficient electricity for its operation.

ECUADOR—United States development of iron deposits and construction of a steel mill in Ecuador has been announced by that country's representative to the United Nations. According to Dr. Jose A. Correa, **Universal Mineral Resources** has acquired concession rights to 50,000 acres of black sand deposits along the coast, and **Koppers Company** of Pittsburgh, Pennsylvania will engineer construction of a mill. The first unit is to produce 125 to 150 tons of steel daily, enough to meet the needs of Ecuador at the present time.



SOUTH KOREA—Discovery of an iron ore deposit in Kyongju has been reported. Estimated extent of the deposit is 1,000,000 tons with an average grade of 66 per-

cent. The **Central Soil and Mineral Laboratory** is said to have confirmed iron content of up to 73 percent. An initial shipment of 120 tons was made to Japan, and the **Pacific Trading Company** in Osaka is said to be seeking an arrangement for importing the ore on a long-term contract. Production has started at a rate of 50 tons per month.

INDIA—**Indian Aluminium Company Ltd.**, subsidiary of the Canadian controlled **Aluminium Ltd.**, has formally opened its new \$10,000,000 reduction plant at Hirakud in Orissa State. The smelter has a capacity of 11,500 tons per year, and more than doubles the country's productive capacity.

MALAYA—Malayan miners expect to have higher tin quotas for the sixth control period which covers April through June as a result of the general increase in the export quota announced by the **International Tin Council** for this period. The quota was raised by 3,000 tons to 23,000 tons for the second quarter of 1959. Based on quotas used before, it is expected that the new Malayan quotas will be approximately 48 percent for European mines and 45 percent for Asian mines. The present quota distribution has been 42 percent for European and 41 percent for Asian. Malaya will be able to export during this period an additional 1,125 tons of tin, or 8,625 tons instead of 7,500 tons.

SOUTH KOREA—The Mining Bureau of the Ministry of Commerce and Industry is interested in renewing negotiations with **Nationalist China** for refining of Formosa's copper ore on a consignment basis. A similar plan was considered several years ago, but the Chinese group renewed its contract with Japan instead.

MALAYA—**Dredge No. 8 of Pacific Tin Consolidated Corporation**, after its trial runs, has been steadily digging its way from the construction site to the main gravel reserve area on the **Berjuntai** property. It has had the usual shakedown problems and had not yet recovered appreciable amounts of tin, at last report. The firm's No. 2 and 3 dredges have remained shutdown, and only No. 5 has been in regular production near Ampang.

SOUTH KOREA—The **Korea Tungsten Mining Company** is seeking government approval to develop the **Yangchi-li** gold and silver mine on a contract basis. The mine is currently producing 1,000 tons of ore per month. Choe Chang-tok, auditor of the company, has been tentatively selected as contractor.

SOUTH KOREA—The **Aero Service Corporation** of Philadelphia, Pennsylvania has completed the first phase of a 10,000-square-mile airborne geophysical survey in South Korea. This is the first airborne magnetometer survey ever undertaken in the country. Approximately 3,500-square miles were logged in the northeast and southeast parts of the country. The aerial search is for iron ore, and is being carried out under an ICA-financed contract with the Korean government. Its purpose is to determine the feasibility of further development of Korea's iron and steel industry, and to enlarge its reserves of iron ore. During the winter season, the crew moved to Thailand for a combined magnetometer and scintillation counter survey for new deposits of iron ore and radioactive elements. This project will cover nearly 4,000 square miles. Cost of both surveys is more than \$200,000.

MALAYA—A Japanese firm, **Kinoshita & Company**, reportedly hopes to mine iron ore in Malaya, in association with local companies, some time next year. A company representative, K. Sasaki, said his firm would provide the necessary funds, machinery, and technicians under such joint projects. A number of Malayan firms are said to be interested in the plans.

INDIA—The establishment of an aluminum plant in Belgaum is under consideration by the Government of Mysore State. Shortage of hydroelectric power is said to be the only obstacle.

PAKISTAN—German engineers recently visited Pakistan to make a general survey of the mineral potentialities. Ore deposits are known to exist, but the quantity and commercial possibilities are not known. The **Geological Survey of Pakistan** has found ore in Baluchistan and in the Tribal areas; it is the function of the **West Pakistan Mineral Development Corporation** to determine the quantity. The Corporation plans to concentrate on lead, copper, zinc, and silver for the present.



SOUTH AUSTRALIA—A recent Australian report states that **International Nickel "Corporation"** has abandoned its small township in the Blackstone Ranges. **MINING WORLD's** Australian correspondent believes that this almost certainly refers to **Nickel Mines of Australia Pty. Ltd.** in which **International Nickel Company of Canada** is said to have an interest. The fact that Inco has been interested in this remote area for some years implies that there is a deposit of some interest there. The area is described as Mount Davies in the Blackstone Range. This is a range of barren mountains rising to a maximum height of 3,000 feet, and is located just inside the Western Australian border near its junction with South Australia and the Northern Territory. The Blackstone Range is really a western extension of the Tomkinson Range (chiefly broken granite) which lies across the Western Australia-South Australia border. The settlement for about 60 people will be left virtually intact. A team of diamond drillers, working at Wingaleena, 35 miles from the main

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camp, is the only remaining party in the area.

FIJI ISLANDS—Nippon Mining Company is reported to be planning to establish a joint venture company in the islands to develop a copper mine there. A team of three mining engineers has been visiting the property recently, and last year S. Nishizawa surveyed the area for the firm and reported a promising deposit. A 6- to 12-month prospecting program is planned by Nippon.

INDONESIA—The Minister of Industries has submitted a bill to the Indonesian Parliament which calls for suspension of mining concessions which were granted by the Dutch government and are not now being developed. According to the Ministry, of the 2,400 mining licenses being held by foreigners, 1,349 are in the hands of Dutch groups and most of these have been idle since the anti-Dutch campaign of 1957. The bill would not affect mining rights granted by the Indonesian government, or mining rights given by the Dutch if the properties are still being developed. Suspension of the inactive concessions would give others the opportunity to develop the properties.

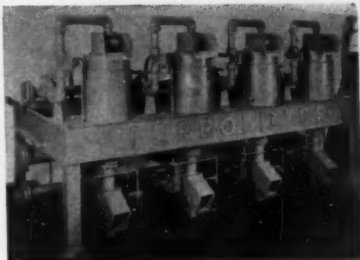
REPUBLIC OF THE PHILIPPINES—Phillex Mining Corporation officials report that the Santo Tomas II mine has begun delivering a higher tonnage of ore to the mill and it is expected that a rate of between 1,400 and 1,450 tons daily will be maintained. Copper recovery continues to be low because of the relative high oxide content of the ore. Water is also a problem, but steps are being taken to prevent an acute shortage.

WESTERN AUSTRALIA—Ravenshorpe Copper Mines N.L. at Ravenshorpe will double mill capacity to 10,000 tons of ore per month. The mine is opening up favorably, although production of concentrates (25 percent Cu) is still only 400 tons per month. Norseman Gold Mines N.L. at Norseman has been steadily buying Ravenshorpe shares and now holds 380,000 shares out of a total of 1,944,000 issued shares. Part of Ravenshorpe's production is being sent to Port Kembla, Australia and part to Japan. It is expected that all will go to Port Kembla by the end of 1959.

REPUBLIC OF THE PHILIPPINES—Lepanto Consolidated Mining Company made its 83rd postwar shipment of copper concentrate during January. Some 10,230 wet metric tons containing 5,693,100 pounds of copper, 9,352 ounces of gold, and 38,124 ounces of silver were shipped to Tacoma, Washington. The concentrate shipment is reported to be the estimated equivalent of 10,221 dry short tons. Copper content is estimated at 27.85 percent; gold content 0.915 ounce per dry short ton; and silver content 3.73 ounces per dry short ton.

VICTORIA—The Victoria Mines Department is busy checking two recent ore discoveries. Torbernite has been found near Lake Boga in the northwestern corner of the state. A scintillometer survey will be made which may be followed by drilling. In the mountainous country to the north of Lakes Entrance, a copper find has been reported, and the Department may drill the prospect.

NETHERLANDS NEW GUINEA—Nickel and cobalt ore reserves have been estimated at between 100,000,000 and 200,000,000 tons by the Netherlands Overseas Affairs Minister. Some large concerns are reported to be considering de-



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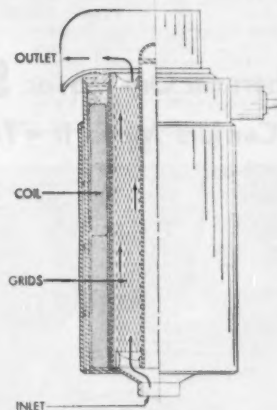
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AB	48"	960 lb.
AB	54"	1080 lb.
3B	36"	1400 lb.
3B	42"	1540 lb.
3B	48"	1730 lb.
3C	60"	2590 lb.
3D	48"	2030 lb.
3D	60"	2865 lb.
3D	72"	3700 lb.
3D	84"	4000 lb.



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velopment of this property with Dutch capital. Economic-geological explorations are also reported to have disclosed the presence of chromite and iron ore.



BRITISH COLUMBIA—Development of Silver Ridge Mining Company's Wonderful mine near Sandon has been taken over by Violamac Mines Ltd. of Toronto

under a profit-sharing plan. H. F. Magnuson of Wallace, Idaho heads Silver Ridge.

ALASKA—DeCoursey Mountain Mining Company, wholly owned subsidiary of De Coursey-Brewis Minerals Ltd., has changed its name to Alaska Mines and Minerals Inc. Improved operations during the six-month period ended November 30, 1958, resulted in production of 1,916 flasks or 145,616 pounds of mercury. A total of 464 flasks remained in inventory at the end of that period, and 1,452 flasks had been sold for \$322,990. In spite of the extremely cold weather in December, production was maintained at a satisfactory level and ore reserves were increased.

NORTHWEST TERRITORIES—Tauranis Mines Ltd. plans to deepen its shaft

by 300 feet this season in order to establish two more levels. The second level (325 feet) will be extended 1,600 feet to the south zone where there may be greater ore potential than on the Matthews Vein.

QUEBEC—A westerly extension of the same type of rocks that hosted the Mattagami copper discovery is now attracting firms to the Quebec-Ontario border near the Turgeon River. Kesagami Syndicate has staked most of the claims—about 1,350, mostly in Quebec. Kesagami is composed of the same group of companies that located the Mattagami Lake Mines deposit being developed by Noranda-McIntyre-Canadian Exploration, and the Kitchigama Syndicate holdings west of Mattagami. The companies in the syndicate are Area Mines, Dome Mines, Highland-Bell, Leitch Gold Mines, Teck-Hughes Gold, and Iso Uranium. Others now staking in the Turgeon River area include Prospectors Airways, Selco Explorations, Belcher Mining, Coniagas Mines, Conwest, Ranworth Explorations, and Jacobus Mining.

BRITISH COLUMBIA—Phoenix Copper Company Ltd. has virtually completed preparations for the start of production at the old Phoenix copper mine near Greenwood. A tailing pipeline has been built from the concentrator to a disposal area and tailing dams are under construction. About 90,000 tons of waste material have been removed from the open-pit mining area and 5,000 tons of ore stockpiled in the process. The company is a subsidiary of Granby Consolidated Mining, Smelting and Power Company Ltd.

NORTHWEST TERRITORIES—Deepening of the "C" shaft is underway at the Giant Yellowknife Gold Mines property at Great Slave Lake. Three new levels are being established at the 1,600-, 1,800-, and 2,000-foot horizons, and a program of about 10,000 feet of lateral work will be carried out. Daily tonnage in the treatment plant has been steadily increasing since installation of the two-stage roasting equipment, and should reach 1,000 tons per day soon. The baghouse unit, also recently installed, is effectively trapping the precipitated arsenic and preventing its discharge to the atmosphere.

BRITISH COLUMBIA—Encouraging drifting results on the "77" and "79" veins on the company's two new levels, the 34 and 35 levels, has prompted Bralorne Mines to start immediate deepening of its Queen shaft to below the 40 level. The shaft presently bottoms below the 36 station, and present production and hoist equipment is capable of handling operations to the 45 level if further sinking is desirable later.

MANITOBA—The second phase of a joint exploration program by Consolidated Marbemor Mines Ltd. and National Malartic Gold Mines Ltd. in the Setting Lake-Mystery Lake nickel belt has been started. An airborne geophysical survey, followed by surface geophysical survey, was made last year, and diamond drilling has been started this season. Midwest Diamond Drilling Company Ltd. is the drill contractor. The property lies between the holdings of International Nickel Company of Canada and Noranda Mines on the Setting-Opwagan-Mystery fault structure.

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SLATE MINE FOR SALE: Top grade for blackboards, switchboards, etc. Near Genoa, Italy; large reserves. Property must be sold; will sell reasonable for quick sale; owner cannot operate. Contact H. C. McKay, Portland, Connecticut.

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WANTED—FLUORSPAR power shovel deposit. Must average at least 25% CaF₂ and be amenable to successful concentration by flotation. Submit details to Chessher & Co., Box 1022, Reno, Nevada.

MANAGER or SUPERINTENDENT: Age 44, married. 20 years' experience in Supt. of Operations, General Supt., Master Mechanic, Mine Engineer, Geologist. Surface and underground mining, plant design, construction and operation. Desire position as manager or superintendent of small metallic or non-metallic mining and milling or processing plant. Location desired, U. S. preferable East. Reply to Box No. K-1, Mining World, 500 Howard Street, San Francisco 5, Calif.

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- 1—Ingersoll-Rand 824 CFM Twin model 90-B, type 40, with 200 H.P., 2300 volt motor—reconditioned
- 1—Ingersoll-Rand Model 40-B, 180 CFM, "V"-belt driven by 40 H.P., 220/440 volt motor—reconditioned
- 2—Gardner-Denver 500 CFM Portable compressors with Cat. Model D 13000 diesel engine

HOIST-SHAFT

- 1—Sullivan, single drum, Model R113, complete with Post Brakes, depth indicator, thrustor brake, machine #10831 complete with 125 H.P., 440 volt slipping motor with Grids and Controller. Rope pull 8700# @ 475 F.P.M.—reconditioned

HOISTS—Tuggers-Slushers (reconditioned)

- 2—Ingersoll-Rand Model DU, single drum, 1000# R.P. @ 75 F.P.M.
- 2—Ingersoll-Rand Model D6U, single drum, 1000# R.P. @ 75 F.P.M.
- 3—Joy Model L111, single drum, 2000# R.P. @ 124 F.P.M.
- 2—Ingersoll-Rand Model 30NM3D, double drum, with 30 H.P. 220/440 volt motors, 3960# R.P. @ 250 F.P.M.
- 1—Sullivan Model F211, double drum, air, 2500# R.P. @ 130 F.P.M.

MINE TELEPHONES

- 17—Western Electric, Metal, Bureau of Mine Plate—reconditioned
- 30—Western Electric, Metal, w/lids—reconditioned

GENERATORS

- 2—25KW International Model UD9 diesel, skid mounted, 230 volt, 60 cycle with panel board—like new
- 2—60KW General Motors Model 671 diesel, skid mounted, 240/480 volt, 60 cycle, with panel board—reconditioned
- 1—125KW General Motors diesel, 480 volt, skid mounted with panel board—reconditioned
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- 1—Symons "V" Screen complete, less cloth and motor—reconditioned

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 1-24" X 5' Denver Adj. Stroke, Belt
 1-24" X 6' Denver Adj. Stroke
 2-24" X 8' Denver Adj. Stroke, Belt
 1-60" X 28' Jeffrey Pan Feeder, 15 HP

Filters
 1-3" X 3" Denver Pan Simplex w/Vacuum
 2-6"-2 disc Oliver, Complete, 1 HP gearmotor
 1-6"-6 disc Oliver, Complete, 3 HP Motor
 1-6"-5 disc Oliver, Complete, 1 1/2 HP G.E.
 1-6" X 6' Oliver, All Stainless, Complete



100 KW Caterpillar Diesel Generator

Magnetic Separators
 1-Dings Magnetic Separator, Type E 24, 13" Belt
 1-Size 1B Stearns Magnetic Separator, Type R, Excellent
 1-Size 12" X 10" Stearns Drum Separator, Type DH
 1-36" Cutler Hammer Magnetic Pulley, Type W
 1-24" Dings BiPolar Suspended Magnet, 30 BP

Sand Pumps
 1-1" Denver Vertical 1 1/2 HP
 2-1 1/2" Denver Vertical, 3 HP
 2-2" X 3" Ash Hydrosol Sand Pumps, A Frame
 10-3" X 4" Ash Hydrosol Sand Pumps, B Frame
 3-5" X 6" Ash Hydrosol Sand Pumps, C Frame
 1-4" Galtiger Vaseal, 30 HP, 440 V
 1-4" Wemco rubberlined, 30 HP, 440 V
 1-4" Wilfey Sand Pump, 15 HP, 440 V

Screens
 1-3' X 6' Symons Rod Deck
 1-4' X 8' Symons Rod Deck
 1-18" X 36" Denver Dillon Single Deck
 1-3' X 10' Allis Chalmers Single Deck

Tables
 1-15 S Diester, Laboratory, 110 V Motor
 1-7' X 15' Diester Plate, 1 1/2 HP, 220/440 V
 1-Size 6S Wilfey, 1 1/2 HP, 220/440 V

Thickeners
 1-38 1/2" X 8' Denver Spiral, Steel Tank

1-50" X 9' Dorr "Torque", Type S
 1-30" X 10' Butchant Mechanism

Blowers
 1-15" LaDel Axial Flow, 1 1/2 HP, 440 V
 2-TM6 Coppus Ventral, 5 HP, 440 V
 1-24" Sturtevant Axial Flow, 5 HP, 440V
 6-TM 7 Coppus Ventral, 10 HP, 440 V
 8-TM 8 Coppus Ventral 15 HP, 440 V
 1-Series 1000 Joy, 10 HP, 220/440 V, NEW
 1-6000 CFM Roots Connorsville, IS, 150 HP, 2200 V

Cars, Mine Ore
 18-18 cu. ft. CS. Card, Z18, 18" ga.
 41-30 cu. ft. C.S. Card, Z30, 18" ga.
 11-30 cu. ft. C.S. Card, Rockerdump, 24" ga.
 32-33 cu. ft. Ajax Type, 18" ga.
 25-40 cu. ft. C.S. Card, Granby, 30" ga.
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 14-84 cu. ft. C.S. Card, Granby 30" ga.
 5-85 cu. ft. C.S. Card, Granby, 30" ga.
 8-93 cu. ft. C.S. Card, Granby, 24" ga.
 7-100 cu. ft. C.S. Card, Side Pump, 30" ga.
 14-130 cu. ft. C.S. Card, Granby, 30" ga.

Compressors
 1-500 CFM Gardner, Denver, HAV, 100 HP, 440 V
 1-625 CFM Ingersoll Rand, XCB, 125 HP, 2200 V
 1-875 CFM XRE, 175 HP, Svm, 2200 V
 1-1000 CFM Chicago Pneumatic, OCB, 200 HP, 440 V
 1-1050 CFM G. D. HA, 200 HP, G.E. 2200 V
 1-2000 CFM Worthington, 400 HP, 2300 V
 1-2500 CFM Sullivan, WN4, 400 HP, West, 2200 V
 1-300 CFM Ingersoll Rand PRE-2, 575 HP, 2200 V

Generators, Diesel
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 1-100 KW Caterpillar D13,000, 440 Volt, Diesel

Hoists
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 1-75 HP Puget Sound Single Drum
 1-170 HP Allis Chalmers Double Drum
 1-600 HP Vulcan Double Drum, 2300 V

Locomotives
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 3-1 1/2 Ton Atlas Type J, Battery, 18" ga.
 1-2 1/2 Ton Jeffrey, 18" ga.
 1-3 1/2 Ton Mancha Titan AX, 18" ga.
 1-10 Ton Davenport, D13,000 Cat., 36" ga.

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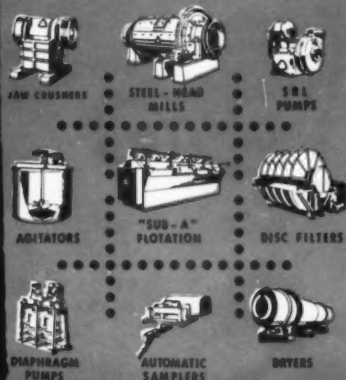
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